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ORE DRESSING AT BROKEN HILL*

Equipment for Crushing, Concentrating and Preparing Ores for Smelting

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The treatment of the Broken Hill ores has undergone many changes during the last 10 years. The want of absolute uniformity in the treatment among the various mines at the Barrier does not prove that some are working on wrong lines, for the ore is not exactly the same along the whole line of lode; this necessitates a variation in treatment, although generally only in detail.

At the Proprietary mine the ore is all mined by contract; the miners are paid so much per ton for clean ore. The ore in the mine in most stopes is mixed with gangue, and the inclination of the miners is, of course, to mix gangue with the ore, so as to be paid for as large a tonnage as possible. Clean ore is easily distinguishable from clean gangue, but most lumps are a mixture of clean ore and gangue in varying proportions. The miner will naturally throw into his heap pieces which he considers still good enough, while the management may consider these pieces just a trifle too poor; consequently a check must be kept on this.

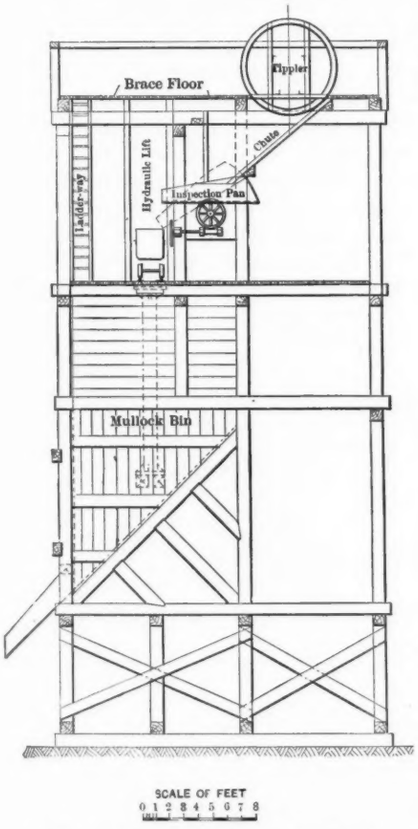

FIG. 1. METHOD OF ORE INSPECTION

This necessitates the first operation to which the ore is submitted. The trucks (tare 5¾ cwt., average load 21 cwt.), as they are loaded underground, have a ticket attached showing to which contract they belong; on arrival at the top of the shaft they are passed over a weighbridge; the weight is entered in a book against the corresponding contract by the company's weigher, checked by a check-weigher appointed and paid by the men; this arrangement avoids all disputes. As the trucks leave the weighbridge, one is selected haphazard, tipped on a short inclined plate, where the ore lies in full view (see Fig. 1). A special man, called an "ore inspector," sorts this truck load; he separates the waste from the ore; the ore is then allowed to fall through a chute into the same truck, which is raised by a hydraulic lift to the original level, and, after being reweighed, rejoins the other trucks on their ordinary course to the mill; the result of the second weighing is that which is booked to the party. As soon as this truck is done with, another is taken, and so on. Generally, one out of every 40 trucks is taken and thus examined. If it is found that any party of men continually loads waste into the trucks, such party is called to account; but this is seldom necessary.

On leaving the weighbridge, the trucks are hitched to an endless traveling steel rope, ⅝ in. diameter; the distance of the trucks from one another on this rope is about 40 ft. The rope takes them to the tipping cradles, but before reaching these cradles they are automatically disengaged from the rope.

As there is a fall from the brace to the tipping cradles of about 9 ft. in a distance of 360 ft., there is very little motive power required to keep the rope in motion; in fact, when the work is fairly regular so that an equal number of fulls are on the down grade as there are empties on the up grade, no power is required at all; power is practically only required on account of want of absolute uniformity in the work. The largest number of trucks disposed of in this manner for one shift of eight hours is 1636, but the average per shift is about 1000.

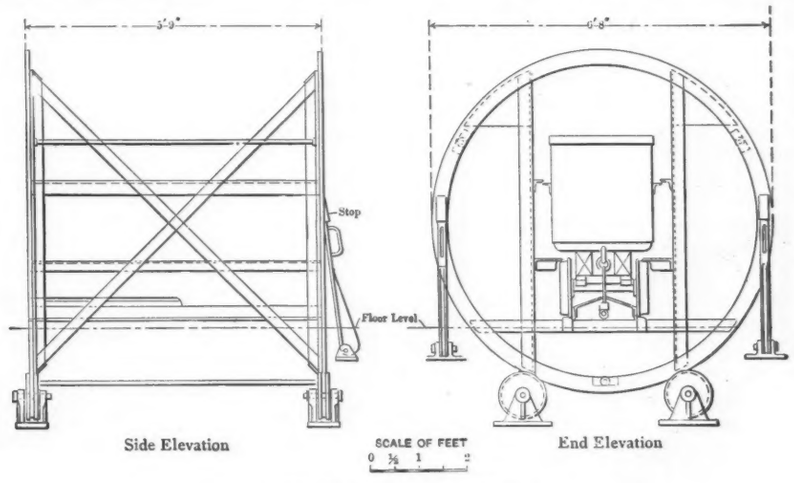

FIG. 2. REVOLVING TIPPLER

CRUSHING AND HANDLING

The tipping cradles (see Fig. 2) are placed above the ore bins. The ore falls over grizzlies of tapered manganese steel. The life of these steel bars is about 12 months. The ore bins hold about 800 tons, and command five Gates crushers,

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No. 5, having openings of 10x30 in. in the spider. The crushers break the ore to 2-in. pieces. The cast-iron cones of these Gates breakers are covered with a removable mantle of toughened steel, and the outside shell of the mortar is lined with manganese steel. It is found that if the liners and mantles were both of manganese steel, the surfaces would wear too smooth, and the ore would not be gripped properly; one requires to be soft for gripping, and the other hard for crushing. The life of the mantles is about 1350 hours, and that of the manganese-steel liners 2700 hours. Many other combinations were tried, such as cast iron with steel, and different kinds of steel, but the above gave the most economical results.

The crushed ore and the smalls then pass together into bins, which in their turn discharge into one-ton trucks. These are raised, two at a time, by means of a hydraulic lift to the original level on the top bins (see Fig. 3). The hydraulic elevator has two crushers on one side and three on the other, and the whole of this crushing plant stands between the two concentrating mills (Fig. 3). When the trucks with crushed ore and smalls reach the top level they are alternately sent to the right and to the left—i.e., to the one mill or the other—each mill having a capacity of about 6000 tons of ore per six working days.

The new mill is the most up-to-date. The course of the ore through the various appliances is shown in Figs. 4 and 5.

The broken ore is tipped from the trucks into bins which command a set of three fast-running rolls 36 in. diameter, 15 in. wide, ⅜ in. to ½ in. apart, with steel shells, and making 37 r.p.m. It is found that the shells which answer the purpose best are those of toughened steel; the thickness of these shells is 4⅛ in., and the life, taken over a good many shells, is approximately 3000 hours. The shells are not turned up, but their surface kept smooth by shifting them sideways occasionally, so that the relative position of the shells opposite one another is not always the same.

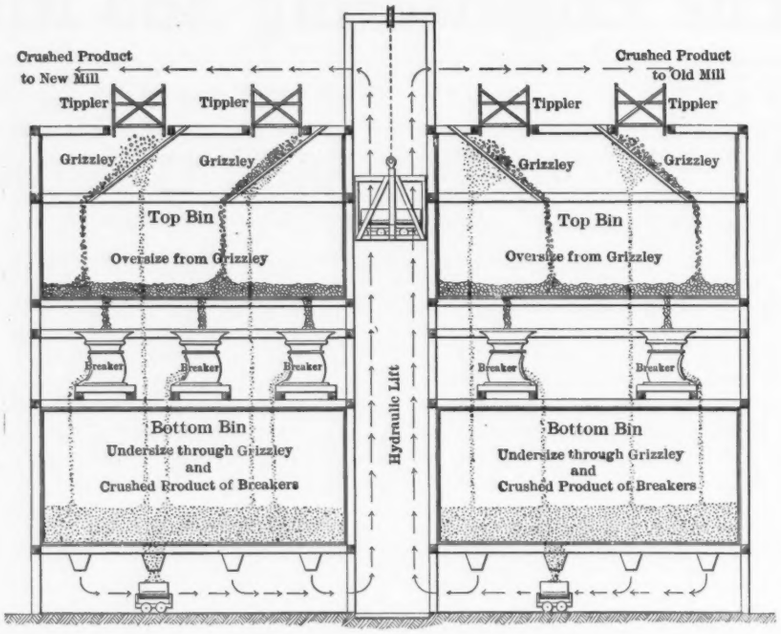

FIG. 3. ORE-BREAKING PLANT

SAMPLING MILL

The sampling of the ore going to the mill is done on the passage from the bins to the crushing rolls; a man goes around every hour and takes a scoop sample from the chutes that lead into the crushers; a sample is made up for every eight-hour shift; the total weight taken during the eight hours is 700 lb. approximately.

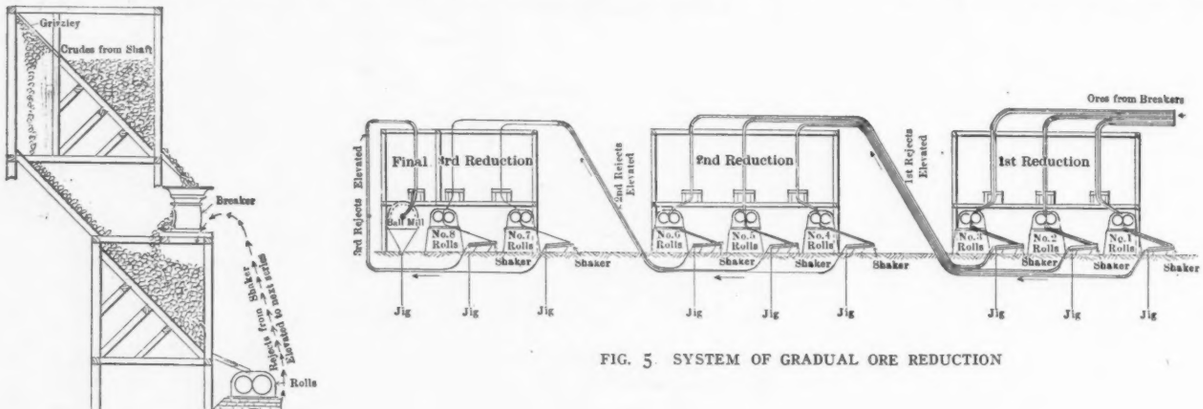

FIG. 5 SYSTEM OF GRADUAL ORE REDUCTION

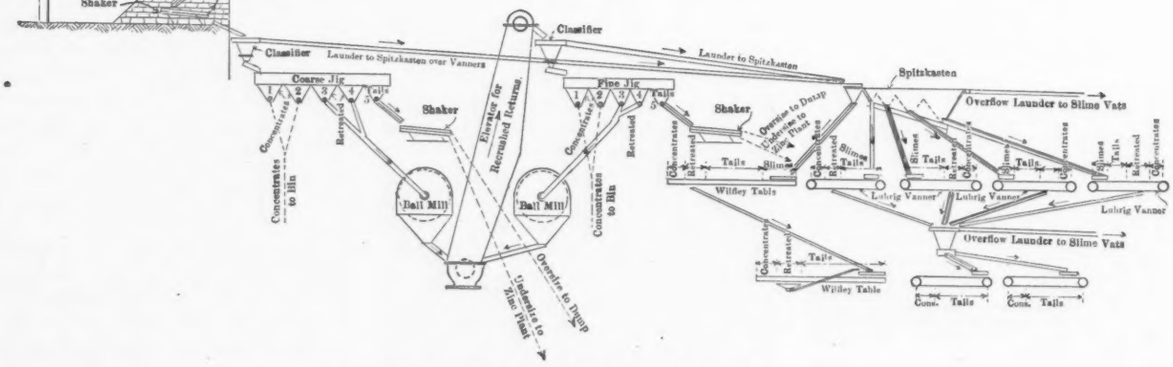

FIG. 4. DISTRIBUTION OF MILL PRODUCTS

This sample goes to the sample mill, which is arranged on the usual pattern—i.e., the ore is crushed fine and mechanically divided and subdivided until a sample is obtained not too large for the assay office. A doubt arose whether or not the sample thus taken could be considered a fair sample. In order to test this, another man was put on to take an independent duplicate sample every hour, but half an hour after the first man. This was done for a period of six weeks; at the end of the six weeks it was found that the first sample assayed 16.46 per cent. lead and the second 16.57 per cent., showing that the method of taking the samples was fairly reliable.

PREPARATION FOR CONCENTRATION

The ore (about 1½ in. to 2 in. in size) is fed automatically into the rolls by means of a roll feeder (see Fig. 6), assisted by a jet of water. On leaving the rolls it passes over a rocking screen (see Fig. 7) with 3/32-in. holes. The through ore goes to the concentrating plant, and the over-size falls on a traveling Balata belt, which discharges into the boot of an elevator, which elevator returns it to the orginal top level, and discharges it into a second set of bins commanding a second set of three rolls, similar to the first set, but grinding finer and revolving at 45 r.p.m., and ⅛ in. to 3/16 in. apart. Here, again, the ore is fed in automatically and follows the same process; i.e., the through ore goes to the concentrating department and the over-size falls on a traveling belt similar to the previous one, and is again raised to the original level and discharged into a third bin. The third bin commands another set of rolls in the same way, which rotate at 78 r.p.m., and 1/16 in. apart; the over-size is raised in the same way into a bin, and from here into the last crusher, which is a No. 5 Krupp ball mill, specially constructed for wet grinding; in this last mill the grinding reaches finality, as no ore can escape the ball mill before it is crushed to a sufficient fineness to pass the screens.

Material which has once passed a set of rolls never comes back to the same rolls, but goes on to another set adjusted differently. In the old mill the usual method is followed of returning the oversize of screens to the same set of rolls. The advantages of the new method are that a much smaller proportion of slimes is made, and that the gradual reduction effects at the same time a gradual concentration. That is to say, that the material fed into the first set of rolls is the richest. After crushing and screening, the over-size which goes to the second set of rolls is poorer, as the portion not crushed fine enough to pass the screen is the hardest and therefore contains most of the gangue. The same selection takes place in the second set of rolls, and so on. The assay value of the feed into the first set of rolls is about 15 per cent. lead, while the feed into the last set of rolls or ball mill is only about 10 per cent. It is found that this automatic selection gives an advantage in the working of the jigs and in the recovery.

The principle of never returning any ore to a machine through which it has once passed, but passing it on to another machine differently set, has been carried out as far as possible all through the mill. It seems right to conclude that a machine which allows material to go through without effecting its purpose should not be called upon once more to do it; the operation should be done in one differently set.

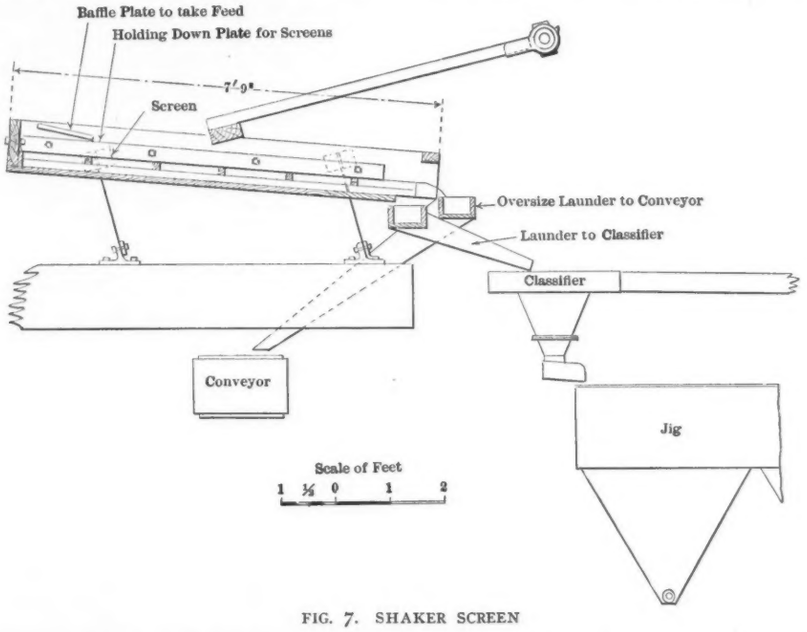

FIG. 7. SHAKER SCREEN

SCREENING

Instead of shaking screens trommels were used at first, but it was found on experimenting with shaking screens that these did much more effective work than the trommels. The trommels only passed through 58 per cent. of the material that was fine enough to go through, while the shaking screen passed through 70 per cent. Other advantages of the shaking screen over a trommel are: (1) less initial cost; (2) less water required for screening; (3) repairs can be done so much more quickly, as it only takes about 10 minutes to replace a screen plate, while in a trommel it takes hours; (4) the screen plate lasts longer in the shaker than in the trommel; the screening area of a shaker is 21 sq.ft., and lasts six weeks; (5) the shaking screen takes up much less room than a trommel, and is much more easily accessible for cleaning while in motion.

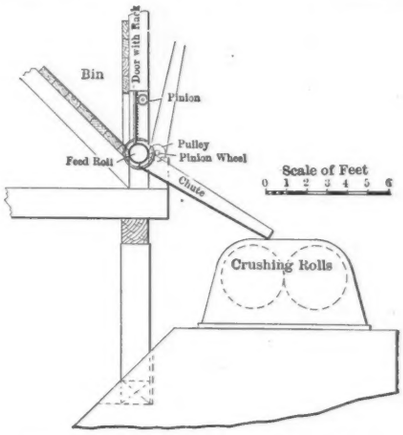

FIG. 6. ARRANGEMENT OF FEED ROLLS

The ore is now all fine enough for the coarse jigs, i.e., it will all pass through a 3/32-in. hole. On its way to the jigs (May plunger jigs with five compartments, see Fig. 8), the crushed material passes through a slime separator—an inverted cone with an inflow of water at the bottom, and an overflow which carries the water charged with all the slimes (see Fig. 9). The coarse part of the material goes to the jigs, and the overflow slimes to the slime department. In the first two compartments of the jigs, concentrates of about 60 per cent. lead are obtained; in the third and fourth compartments a product assaying about 10 per cent. lead, 19 per cent. zinc, and 10 oz. silver; and in the last compartment tailings assaying from 3 to 4 per cent. lead.

The discharge from these jigs is through a spigot at the bottom, and is continuous. The concentrates run through launders into bins above the railway line, where they are drained of water, and when dry enough run into railway trucks. The tailings are also run into bins, from which they are trucked to the tailings heap. The middle product is discharged into a No. 4 ball mill with slotted screens, 1/32-in. slots; the resulting pulp is raised by means of a bucket elevator into the fine jigs of four compartments, but on its way to these jigs it passes through a slime separator similar to the previous one, so as to remove the slimes, which again go to the

slime department. The fine jigs make concentrates assaying 40 per cent. lead, 13 per cent. zinc, and 22 oz. silver; a middle product assaying about 9 per cent. lead, 18 per cent. zinc, and 10 oz. silver; and tailings assaying 5.5 per cent. lead, 18 per cent. zinc, and 8 oz. silver. The concentrates and tailings are disposed of in the same way as with the coarse jigs, and the middle product passes into another ball mill with screens with slotted holes 1/45 in. wide, and the resulting pulp is raised

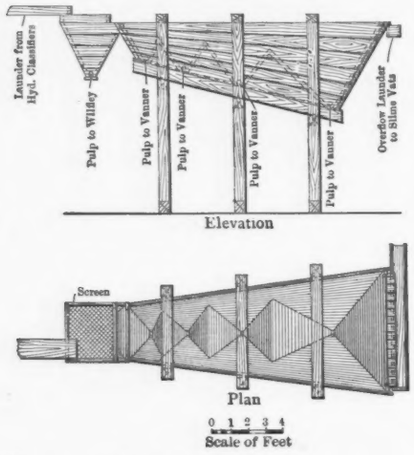

FIG. 10. SPITZKASTEN

up to the slime separator belonging to the fine jigs. No handling of material takes place; every product finds its way automatically to its destination right through the process.

CONCENTRATING PLANT

The slimes coming from the various slime separators pass into "V" boxes (see Fig. 10), where they are classified into coarser and finer slimes. The coarser slimes go to Wilfley tables, and the middlings from these over a second set of Wilfley tables at a lower level, the concentrates finding their way to the concentrate bins, and the tailings to another set of bins, from which they are removed to the zinc-treatment plant. The finer tailings classified into four sizes go to the Luhrig vanners, upper and lower set, the same as the Wilfley, and the concentrates and tailings are disposed of in the same way.

During the crushing and subsequent grinding a fine slime is formed, which settles with great difficulty in the circulating water and runs past all the concentrating appliances. These slimes contain about 18 per cent. lead and 18 oz. silver and form a very substantial portion of the total ore treated. At one time these slimes were allowed to run away mixed with the tailings as untreatable, but now the circulating water is settled in a number of large tanks and the resulting slimes (about 1500 tons weekly, or about 12 per cent. of the total ore treated) are collected and further treated by means of the sintering process, which will be described later on.

The recovery of lead in coarse jigs is 47.5 per cent.; in fine jigs, 13.5 per cent.; on Wilfley tables, 3.15 per cent.; on Luhrig vanners, 3.15 per cent. The quantity put through coarse jigs, double, per hour is about 5¾ tons; fine jigs, double, 2¾ tons; Wilfley tables, ¾ ton; Luhrig vanners, single belt, 1/6 ton.

From the former operations four products are obtained:

Lead concentrates, averaging 55 per cent. Pb, 10 per cent. Zn, 26 oz. Ag.
Coarse tailings, averaging 4 per cent. Pb, 12 per cent. Zn, 5 oz. Ag.
Fine tailings, averaging 5 per cent. Pb, 17 per cent. Zn, 8 oz. Ag.
Slimes, averaging 18 per cent. Pb, 17 per cent. Zn, 17 oz. Ag.

The total quantity of ore put through the two mills is about 12,000 tons per week.

It will be noticed that sizing the broken ore previous to jigging is not done. At one time it was thought that sizing the ore—as is the practice in most concentrating mills—might be an advantage, but exhaustive trials made in this direction proved that with the Broken Hill ore there was no advantage in doing this. This may be due to the fact that the mixture of ore and gangue is so intimate that before any concentrates can be obtained crushing through a 3/32-in. mesh is necessary, and to size material smaller than this would be a cumbersome operation when dealing with such large quantities. However this may be, sizing did not give any higher recovery, nor was it more economical, and the idea was abandoned.

DISPOSAL OF THE PRODUCTS

(1) The slimes go to the sintering works; (2) the coarse tailings (3500 tons per week) are transported by means of electric motors to the tailing dump and will be treated later on for zinc; (3) the fine tailings go to the zinc-concentrating department direct; (4) the lead concentrates (2200 tons per week), after draining, are automatically discharged from the bins into railway trucks and sent to the smelting works at Port Pirie.

The two products, lead concentrates and slimes, which are sent away from Broken Hill (the first direct to the smelters and the latter first to the sintering works and subsequently to the smelters) contain about 80.5 per cent. of the total lead contained in the original ore; this is an average taken over about three years.

During the operations in the mill, especially in the jigs, a voluminous scum is formed on the surface of the water; the air and gas freed from the water float sulphides to the surface and there form this scum. The gas shows a selective action, as the gangue is not thus floated. An assay of this material proved that the sulphides thus floated were very much richer in silver; the ordinary concentrates assay from 25 to 30 oz. to the ton, but these concentrates assayed from 60 to 80 oz. At one time, as far back as 1899, this scum used to be collected and bagged separately, and sent to the smelters direct.

The four products from the ore-dressing mills are dealt with as follows:

SINTERING OF SLIMES

The fine slimes which are settled in large iron settling tanks are run in a semi-fluid condition over the ground alongside the railway in a layer of about 9 to 12 in. thick; here they are allowed to dry; after a couple of days, according to the weather, they are, when still very plastic, cut up with spades into blocks like peat, about 4 to 6 in. across; these blocks are allowed to dry for a few days more, and when hard enough to handle (after four days in summer and longer in winter) they are loaded into trucks and railed along the Silverton tramway to the sintering works, about five miles out of Broken Hill. Here the blocks are built into heaps

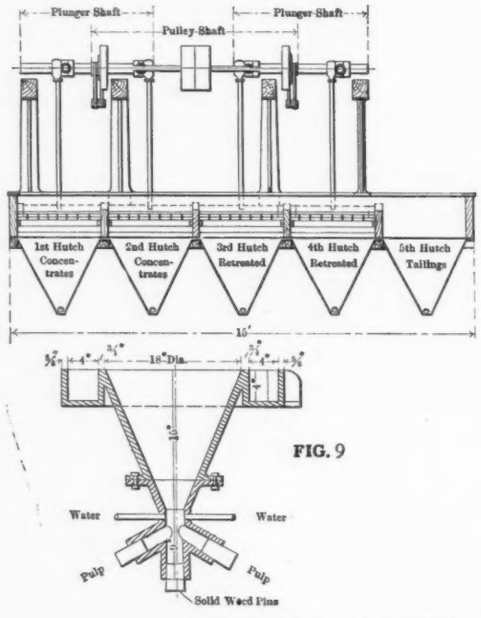

FIG. 9

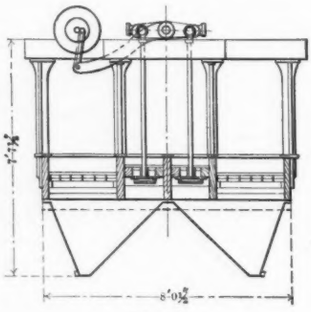

FIG. 8

COMPOUND JIG AND HYDRAULIC CLASSIFIER

with brick air channels at the bottom; the sides of the heaps are plastered over with wet fine slimes, a space being left open at the top for fumes to escape. The heaps are about 20 to 22 ft. wide, 6 ft. 6 in. high, and 200 to 250 ft. long, and hold about 1000 to 1500 tons each. A small wood fire is kindled at the entrance of the air channels, and kept burning for a day or two, by which time the whole of the heap is generally burning right through and is red hot inside. About 1½ per cent. of wood is used to kindle these heaps. The heaps take about 10 to 15 days to burn, according to the strength of the wind and the dryness of the lumps, and give off a large quantity of SO_2 gas. After burning, they cool down gradually until cool enough to be handled. The outside lining is then taken off, mixed with water, and used for plastering over new heaps. The inside is then found to have run together in hard, porous lumps, which require considerable hammering to break up into pieces of manageable size. A great part of the sulphur has been driven off, and a good percentage of the zinc. The assay of the slimes before burning is 17 per cent. lead, 17.5 oz. silver, 16 per cent. zinc, and 12.5 per cent. sulphur. After burning, the sintered slimes contain 14.5 per cent. lead, 15.8 oz. silver, 12.5 per cent. zinc, and 7.1 per cent. sulphur.

The loss of lead is considerable, and in this respect the process is a crude and imperfect one. At the same time, the cheapness and simplicity of the operation, coupled with the absence of any plant, to a great extent make up for this. Seeing that about 100,000 tons of slimes are treated in this way every year, it is clear that any roasting plant capable of dealing with this quantity would require to be very large, and, taking all these things into consideration, it seems that the present imperfect process is likely to hold its own for a long time to come. The resulting product—sintered slimes—is particularly well suited for the smelters, as the lumps are hard and porous, and as much as 500 tons a day has been run through the smelters.

THE JIG TAILINGS

The jig tailings, previous to being trucked out on to the dumps, are passed over shaking screens in order to separate all that material which is already fine enough for the zinc plant. About 30 per cent. of the total passes through the 40-mesh screens, and is sent direct to the zinc plant; the remainder is sent to the dumps for future grinding and treatment at some later date.

THE FLOTATION PLANT

The fine tailings are loaded into bottom hopper trucks, holding about eight tons each, and are taken to the zinc plant. This plant is made up as follows (see Fig. 11):

An elevated railway takes the material (fine tailings from the mill) into bins. From these bins it is fed automatically into vats, where the separation takes place. These vats are inverted wooden pyramids (see Fig. 12) lined with sheet lead. It will be noticed on the sketch that these vats have two pockets at the bottom—one without an outlet, and one with an outlet. Iron pipes introduce the solution into the vat, close to the bottom; one of these pipes discharges into the blind pocket, and the other into the pocket with an outlet.

The operation is as follows: Solution is introduced into the vat, but, as the quantity introduced is more than can run out through the bottom outlet, a large quantity overflows at the top over an overflow specially arranged for this purpose. The tailings are then fed mechanically from the bin into the vat, above the blind pocket. This blind pocket collects all heavy stones, bolts, nails, etc., which otherwise would obstruct the outlet. As the material falls into the blind pocket, it is washed over the partition which separates the two pockets, and passes out through the outlet. On its way down the vat, however, the solution acts on the carbonates contained in the ore, and produces bubbles of CO_2 gas. This gas shows a selective action; it adheres to the particles of blende and galena, but not to the particles of gangue, chiefly quartz and rhodonite. The bubbles of gas cause the particles of blende and galena to float; they come to the surface, and are washed away through the overflow.

The overflows of all the vats join together in one launder, which discharges into a set of wooden tanks, where the particles of blende and galena lose their bubble of gas, fall to the bottom, and fill the tank. When the tank is full, another tank is filled, while the full one is being drained, washed with clean water to remove any trace of chemicals, drained again, and when dry enough discharged and loaded into railway trucks.

It is found that each vat—of which there are six—can treat from 10 to 12 tons of material per hour. The speed depends greatly on the fineness of the material. Each tank—of which there are also six—holds about 50 tons of concentrates. About 240 tons of concentrates is the daily production, but as much as 300 tons per 24 hours has been produced.

The bottom outflow from the vats carries all the gangue with it. The solution and gangue together fall on a 3-ft. india-rubber traveling belt, with side rollers to make it into a trough. The belt runs up hill, which causes the solution to run into a sump, while the solids settle on the belt, are carried up hill, draining all the time, until at the end pulley of the belt they are sufficiently dry to be used as filling underground. The belt discharges on to a narrower flat belt which in its turn discharges the waste into the open cut, from where it is distributed into the various mullock chutes.

The solution used in the vats is a solution of $NaHSO_4$ (a by-product in the manufacture of nitric acid). The temperature most suitable is about 180 deg. F.; in order to reach this temperature, superheated steam of 500 deg. F. is introduced into the solution vats, which stand on a high enough level to command the whole plant. Air jets return the spent solution into this solution vat.

As there are no moving parts in the plant, except the mechanical feeders and traveling belt, the bill for repairs is a very light one. Two engines of 10 h.p. each supply all the power required, except that for the air jets.

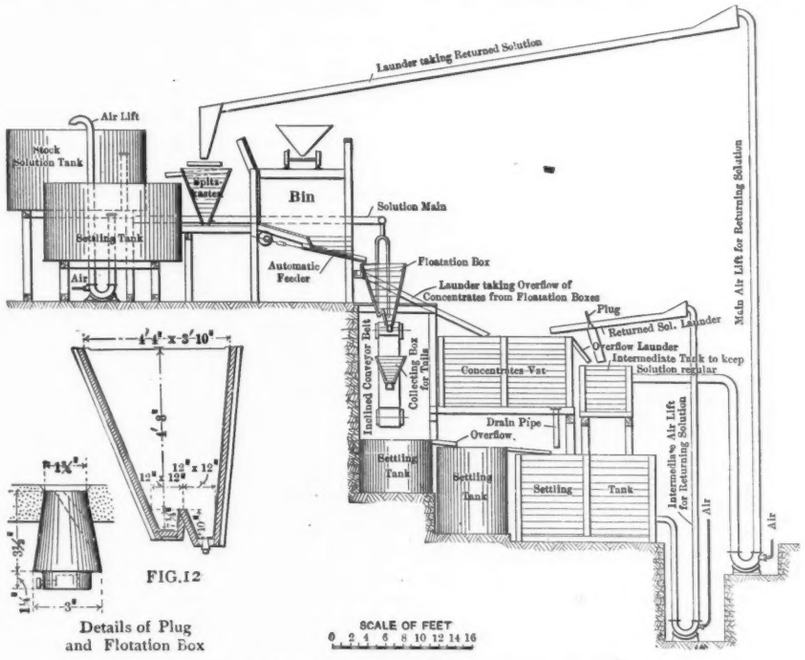

FIG. 11. CROSS SECTION OF 6000-TON ZINC PLANT

FIG. 12

Details of Plug and Flotation Box

DEEP MINING IN THE LAKE SUPERIOR COPPER DISTRICT*

Methods of Hoisting—Difficulties of Surveying—Concrete Bed for Inclined Track

BY F. W. McNAIR†

The copper mines of the Lake Superior district are essentially low grade. Their profitable operation is made possible by the great extent of the lodes, their comparative uniformity of character and the investment of great sums of money to maintain operations on a vast scale over a long period of years.

With but one important exception the lodes are the vesicular tops of ancient lava flows which subsequent to solidification have had the cavities wholly or partly filled by the deposition of various minerals, among which is native copper. They dip at angles varying from 38 to 70 degrees.

METHODS OF HOISTING

The modern shafts through which the rock is hoisted are either inclined, following the plane of the lode, or are vertical. The inclined shafts are of dimensions such as to provide for two railroads of approximately standard gage on which run the skips, which are operated in balance. In addition there is room for the ladder way and air pipes, usually at one side. The vertical shafts have compartments providing usually for cages and pipe and ladder way. Several of the inclined shafts are over 5000 ft. long. One has a length of 8100 ft. Of the vertical shafts the three deepest are respectively about 5200, 5000 and 4900 ft. deep.

LIMIT OF POSSIBLE WORKING DEPTH

Long before such depths were actually reached there arose the question as to a possible limit set by the ultimate crushing strength of the rock which is penetrated. Manifestly mining cannot go to a depth such that the weight on walls of drifts and stopes will exceed the ultimate strength of the material of which they are composed. There is a widespread impression that the lake mines are approaching such a limit. There are current statements to the effect that pieces of rock occasionally snap off the rock faces because of the great strain, and are violently projected as if propelled by an explosive.

In this connection a few figures will be of interest. The average density of the rock of the copper-bearing series is not far from 2.87, that is, a cu.ft. weighs about 179.3 lb. Therefore a horizontal sq.ft. of area at 5000 ft. from the surface has above it a column of rock weighing 448 tons. The ultimate crushing strength of the average rock is not well known, but since it is mostly trap this may be safely assumed as at least 1200 tons per sq.ft. If, therefore, the sq.ft. above defined carries the entire column above it, it is loaded to much less than half the crushing strength and only at nearly three times the assumed depth will the load reach its crushing limit. At a dip of 38 deg., the pressure normal to the plane of the lode at 5000 ft. from surface is only 354 tons per sq.ft. It is in this direction that the crushing forces are mostly called into play. As the dip increases this normal pressure of course diminishes. At 52 deg. it is 278 tons, and at 70 deg. it is 152 tons per square foot.

WEIGHT UPON PILLARS

However, the matter does not end here. The removal of large portions of the copper zone leaves considerable areas of the roof or hanging wall to be supported by the pillars which are left for the purpose, or by the walls of the opening, or by both. The weight on pillars and walls is thus increased and may easily approach the crushing limit. Take for example a long pillar 50 ft. wide having on either side an open space of 150 ft. Suppose it to be a lode dipping at 38 deg. Allowing for neither rigidity nor arching, and supposing the weight on the pillar evenly distributed, at 5000 ft. depth it would be subjected to a pressure of 1239 tons per sq.ft., a pressure under which it would fail.

As a matter of fact in such a case the rigidity of the rock mass distributes a large part of the load out over the rock beyond the walls of the opening. That this rigidity may be considerable is illustrated in several cases where areas of hanging as wide as 200 ft. or more have no support between walls, and yet have stood up for several years. They are not, however, at maximum depth.

HOW PILLARS FAIL

In such an area a pillar when first cut out may have to carry but little more than its previous load. As the hanging wall slowly bends, the pillar must take up more and more of the extra weight. This is not applied uniformly. As the rock between pillars and walls bends downward the tendency is to concentrate the load at the edge or face of the pillar, or wall, much as a beam does when supported in like manner. The outer parts of the pillar may thus become overloaded and here it will fail.

It does so by the splitting off of pieces of rock much as may sometimes be observed with a specimen in the testing machine, though on a much greater scale These pieces break from the base as well as the top, and, as a rule, like any hard rock under a crushing load, the pillar fails suddenly. Small pieces of rock may fly a considerable distance, and such occurrences have undoubtedly given rise to the exaggerated impression of the compressive stress to which the rock is subjected in the lowest levels.

READJUSTMENT OF THE WEIGHT

The hanging rock mass moves of course when the pillar crushes, and the vibration due to the sudden though slight displacement is often conveyed to the surface. The result is a miniature but perfectly genuine earthquake which may be felt over a distance several times that of the pillar from the surface. With the crushing of the pillar and the movement of the hanging, a re-adjustment of the weight takes place, and the process begins over again. Instead of the process being repeated in exactly the same manner, it is possible for the hanging to break in such a manner that the arching effect may protect this pillar and place the load on others. Eventually at great depths the hanging and fort must come together, and in one mine the final steps in the process came so rapidly as to completely wreck it.

The pressure normal to the plane of the lode is not the only stress which may become manifest. The pillars are not as a rule separate from either foot or hanging. They are parts of the same rock mass, and it is not possible for the hanging to slide over the pillar. In consequence the readjustments which take place when a pillar fails as above described sometimes put an enormous longitudinal thrust on the foot, and in places its surface portion has buckled up under such stress. Also, at points where shaft pillars have been weak, shafts have been pinched and twisted under the same conditions so as to interfere with their operation.

IMPOSSIBILITY OF SUPPORTING HANGING ROCK PERMANENTLY

Experience seems to have shown that at the great depths recently reached it is useless to expect to hold up the hanging rock mass for a long time by any scheme of pillars unless far too much of the lode is left in place, and that the only feasible method is to cut away the entire lode and permit the hanging to cave as rapidly as it will to the point where the broken rock again fills the whole space, and redistributes the weight over the footwall. Following this plan stoping begins at the point farthest from the shaft and progresses toward it. With a wide shaft pillar, or with the shaft in the footwall, and with some such general method which avoids concentration of pressure where it can do harm, there seems no reason to anticipate serious difficulties due to crushing

*From the vice-presidential address read before Section D, Mechanical Science and Engineering, of the American Association for the Advancement of Science, at the New York meeting, Dec. 28, 1906.

†President, Michigan College of Mines, Houghton, Mich.

for a farther depth at least as great as that already attained.

DIFFICULTY OF SURVEYING DEEP SHAFTS

The difficulties of surveying the mine are not markedly increased by depth, except in the case of vertical shafts. When these are deep, and it becomes necessary to carry down an azimuth from the surface by means of two plumb lines hung in the shaft, there is presented a problem of considerable difficulty. It is almost impossible to free the lines entirely from disturbing influences which displace them from their normal positions. If either lines or plumb bobs are of magnetic material the presence of iron pipes in the shaft may result in seriously disturbing them. Falling water may be in such quantity, and so directed as also to affect the position of the lines.

However, the air currents, which cannot be wholly eliminated whatever the precautions taken, are the most serious cause of disturbance. The temperature at the bottom of the shaft is higher than that at the top, and in consequence convection currents are formed. The heat supplied from the surrounding rock keeps them up. Indeed, with moderately steady temperature at the surface and with the shaft idle, a remarkably stable condition of these air currents may come about. Elsewhere observations have been published by the writer[1] showing that their effect on a plumb line may remain sensibly constant for hours at a time while deflecting the line from its vertical position. The stability of the currents is made possible by the large cross section of the vertical shafts, 10x22 ft. to 10x30 ft. outside of timbers, thus giving a large air body, and the constancy of the rock temperatures, and the supply of heat through the shaft walls. When we take account of the fact that a force equivalent to a horizontal pressure of 10 grains on a 60-lb. plumb bob suspended by a line 4000 ft. long will displace the bob 1/10 ft. from its normal position, it is easy to see how apparently slight causes may produce appreciable error in azimuth.

DIVERGENCE OF LONG PLUMB LINES

General attention was first attracted to this problem by the very noticeable divergence of two long plumb lines hung in shaft No. 5 of the Tamarack mine. Of course, divergence alone would not affect azimuth, but the question confronting the surveyor is whether the divergence may not be due to some cause which may also displace one or both of the lines in a direction perpendicular to their plane. In the case mentioned it required a great deal of investigation and experiment to fasten the responsibility on the currents of air.

It is remarkable how many persons are ready to accept as an explanation of such divergence the statement that there is an excess of gravitation on each bob horizontally toward the end wall nearest which it hangs. All are familiar with the picture in the text-books of the plumb line hanging near the face of a precipice being deflected from the vertical by the attraction of the mountain mass. The idea so strikingly conveyed by this picture while qualitatively correct seems in most minds to be quantitatively wrong. There is an excess of attraction on the bobs, as stated, but its amount is far too insignificant to account for any observed divergence. At Tamarack No. 5 it could account for no more than one-thousandth of a foot. The convergence of vertical lines in that instance is over three times this amount.

EXPENSE OF HOISTING FROM GREAT DEPTHS

Increased depth tends to lessen the output of a given shaft, and in the effort to prevent this, and also to reduce hoisting charges, loads have grown larger, likewise the speed at which they are hoisted. Loads of nearly 7 tons are being raised on some of the inclines at speeds up to 40 miles per hour.

A considerable item in the hoisting charges is the cost of maintenance of the skip road, the expense per ton for this purpose increasing with the length of the shaft. The usual skip road is carried on heavy timbers which are placed transversely along the foot, and support large stringers to which the rails are spiked. The expense of maintenance of this road for great depths is such that some of the mines are substituting for it a road consisting of a rail attached to a concrete stringer which is borne directly on the rock of the footwall.

CONCRETE STRINGERS

The stringer proper is about 13½ in. wide by 14 in. high. Beneath it and supporting it is a mass of concrete 16 to 18 in. wide, extending to the rock. The depth of this supporting mass varies considerably, depending on the irregularities of the rock face to which it is attached. It ranges all the way from 4 in. to 2½ ft., and there is no reason why these limits might not occasionally be exceeded. The stringer and supporting mass are structurally one piece, being molded together. The stringer portion is reinforced by means of a 1⅛-in. steel cable passing longitudinally through its interior. The rail is attached by bolts, which are spaced 3 ft. apart, and hold it by means of clips which grasp the rail flange. The bolts pass through the stringer into a rectangular opening about 3x4 in. in section, which passes quite through the concrete and affords access to the lower end of bolt.

In building the road, a form of plank is constructed, having the cross-section of the stringer and a length of 15 ft. To its lower side are nailed the cores for the bolt openings just mentioned. The top is left open. From one to three of these forms are supported in place underground by suitable means, and to the sides are nailed boards extending downward to the rock. These make the form for the supporting part underneath the stringer proper. When all is firmly secured, the rock face is thoroughly washed and the concrete is filled in, beginning at the lower end. The mixture used is 1 part portland cement, 3 of sand and 5 of crushed rock, and it is tightly rammed in place. As the filling proceeds, the top of the form, or the cover, is completed by nailing on short pieces of plank. In the roads which have been built at a slope of 70 deg. the structure is anchored to the footwall by heavy bolts spaced 8 ft. apart. When the concrete has hardened sufficiently, the form is removed and the rail is bolted in place. The road is then complete.

The first of these roads has been operating about three years and has proved so satisfactory that the construction of others has followed. Expectations regarding cost of maintenance have been fully realized. In addition, it has been found that the original cost of the road is less than that of wooden construction. Its disadvantages seem to be confined to the fact that, due to the unyielding nature of the support, the effect of a blow must be absorbed between wheels and rail, resulting in a perceptibly greater deterioration of both. However, this is far more than compensated by the decreased cost in other directions and the fireproof character of the road.

ECONOMICAL GENERATION OF POWER

In the effort to counteract the increased costs due to great depth the economical generation, distribution and use of power have naturally received large attention. The long period of operation necessary makes it worth while to expend large amounts of money in installing machinery of large capacity and high economy. The extreme in the direction of high-duty engines is represented at present in the Nordberg quadruple expansion two-stage air compressor operating at the Champion mine. The engine is equipped with Nordberg's regenerative feed-water heating system. It holds the world's record for minimum consumption of heat per foot-pound of work delivered, having shown a duty of 195,000,000 foot-pounds, being about 9 per cent. in advance of its nearest competitor.[1]

A bill has been introduced in the Prussian Diet providing that no concessions for coal mining or for potash salt works shall in future be given to private individuals or companies in Prussia. Those holding such mining rights will not be interfered with; but it is the intention of the Government to reserve all such rights in respect to coal and salts to itself for the future.

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[1] ENGINEERING AND MINING JOURNAL, April 26, 1902; *Electrical World*, April 26, 1902.

[1] "A High Duty Air Compressor," by Prof. O. P. Hood, *Transactions* American Society of Mechanical Engineers, 1906.

THE WALLAROO SMELTING WORKS*

Copper Smelting in South Australia—Ores, Methods and Products

BY T. C. CLOUD†

The Wallaroo Smelting Works are situated in South Australia, on the foreshore of Wallaroo bay, on the west coast of Yorke's peninsula and within three-quarters of a mile of the Government jetty. The land upon which they are built is partly reclaimed from the foreshore and partly high-lying ground forming the original shore. The block of land altogether comprises 70 acres, part of which is occupied by the slag dump. The works are so situated and laid out that, while the furnaces occupy the lowest level, the ore yard is 25 ft. higher.

GENERAL PLAN

The ore yards are provided with railway lines connecting directly with the Government railway, which latter communicates with the Wallaroo and Moonta mines and the Government jetty at Wallaroo, as well as with all parts of the colony and the Broken Hill district of New South Wales. Ore from over sea, from any part of the colony, or from the district of Broken Hill, can thus be discharged directly in the yards.

The yards are suitably provided with ore bins, ore sheds, sampling floors, etc. There is a crushing plant in connection with the yards for crushing ores, slags, etc., consisting of a stone-breaker, Cornish rolls, screens, etc. An overhead tramway stage leads from the crusher and commands the whole length of the ore yard. The copper-smelting department and the gold and silver ore-smelting department are quite separate, each having its own ore yard, furnaces, flues and chimneys.

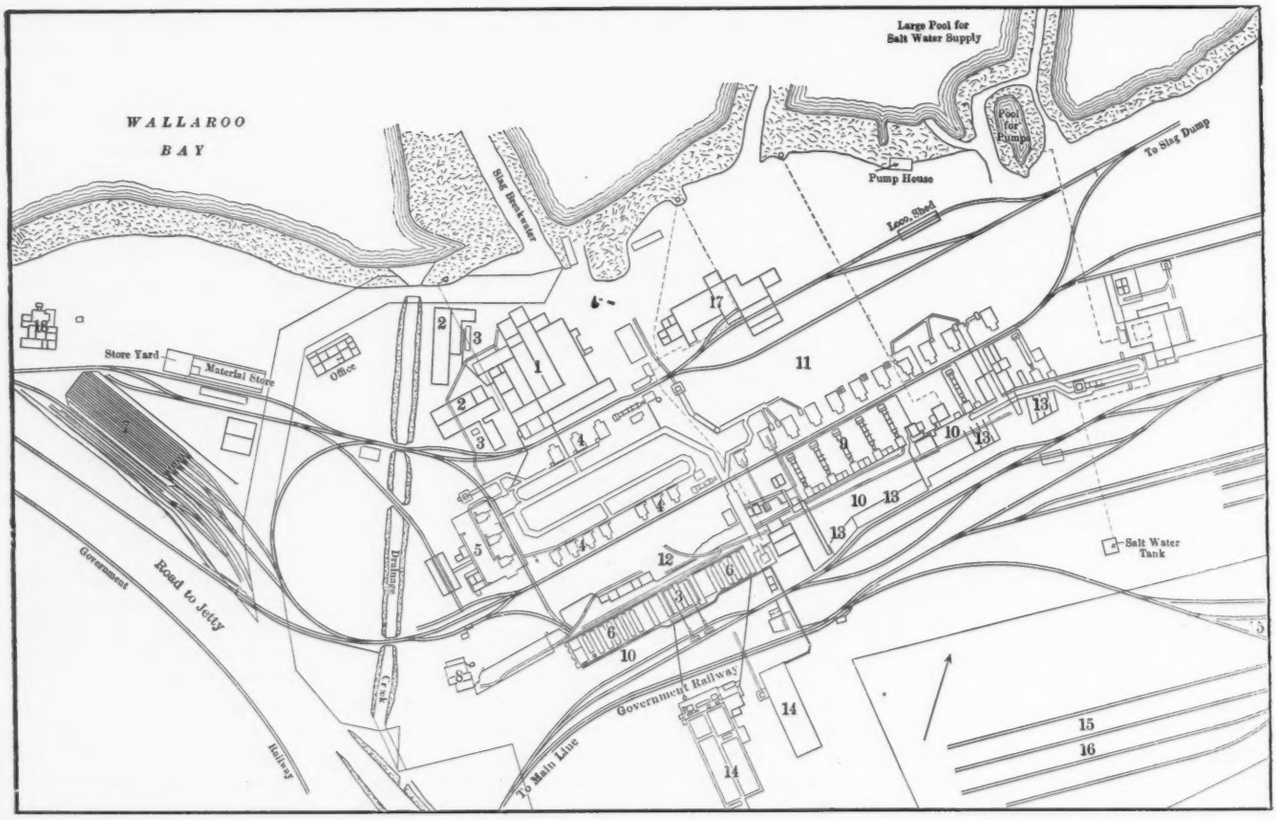
Although the chief work carried on is the smelting of copper ores, there are other subsidiary departments which have grown up of late years, but brief mention only will be made of these here.

The departments referred to are as follows: Copper sulphate works, capable of turning out about 500 to 600 tons of sulphate per annum; sulphuric acid works, with an output of about 5000 tons of chamber acid per annum; a department for the smelting of refractory gold ores, using copper as a collecting material, and, combined with this, an electrolytic depositing plant turning out about 12 tons of copper per week; also an electrolytic plant for parting gold and silver.

THE ORES TREATED

The following are the classes of copper ore which are received for treatment: Ores containing sufficient gold or silver, or both, for profitable extraction; ores containing impurities in larger proportion than occurs in the average ore received from the company's own mines; ores raised at the Moonta mine and the Wallaroo mine, both the property of the company; ores purchased in the immediate district and elsewhere in Australia, which are as free from impurities as the average ores raised at the two mines belonging to the company.

At the period to which the following description particularly refers (1902-03), the ores from the Moonta and Wallaroo mines consisted for the most part of chalcopyrite



PLAN OF THE WALLAROO SMELTING WORKS

1. Engine rooms.
2. Copper sulphate houses.
3. Pyritic burners.
4. Roasters.
5. Copper refinery.
6. Ore kilns.
7. Coal storage ground.
8. Firebrick works.
9. Ore calciners.
10. Copper ore yard.
11. Reducer furnaces slag floor.
12. Roaster slag floor.
13. Ore sheds.
14. Sulphuric acid works.
15. Phosphate works.
16. Storage ground for phosphate.
17. Blacksmith and carpenter shops.
18. Assay office and laboratory.

*From a paper read before the Institution of Mining and Metallurgy, Nov. 15, 1906, with illustrations and with additions and alterations by the author.

†Consulting metallurgical engineer, London, England; formerly manager of Wallaroo works.

mixed with varying proportions of pyrite. A small proportion of the ore from the Moonta mines consisted of bornite, and occasional parcels consisting chiefly of copper glance were received. Generally speaking, the ore from the Wallaroo mine carried a larger proportion of pyrite than that from the Moonta mine. The chief minerals forming the gangue of the ore are quartz, feldspar, biotite, hornblende, ankerite and calcite, while apatite, fluorite and scheelite also occur in small quantities. The other metallic minerals which occur in small quantities with the ores are sphalerite, galenite, molybdenite, cobaltite, martite, native gold and pyrrhotite. The ore as received at the works is either hand-picked and broken to about 2½ in. gage, or jigged concentrates or slimes and fines, the proportions being about 13 to 20.

The ores purchased in various parts of Australia are oxidized copper ores consisting of green carbonate and cuprite, with occasional parcels containing a large proportion of the copper in the form of atacamite and ores consisting chiefly of bornite and copper pyrites, comparatively free from iron pyrites. The oxidized ores here referred to come to hand for the most part as hand-picked ore broken to about 2½ in. gage, while the sulphide ores mentioned reach the works as jigged concentrates and slimes. Hand-picking or dressing is done at the mines, and the figures given below, representing the composition of the ore, refer to the dressed ore as received at the works.

The average composition of the ore received from the two mines belonging to the company is approximately as follows:

COMPOSITION OF ORE FROM WALLAROO AND MOONTA MINES

	Wallaroo Mine.	Moonta Mine.
Copper	13.00 per cent.	19.00 per cent.
Iron	26.10	25.26
Sulphur	22.15	17.82
Silver	0.0023 = 15 dwt. per ton.	0.0020 = 13 dwt. per ton
Gold	0.0002 = 1 dwt. 7 gr. per ton	0.0002 = 1 dwt. 7 gr. per ton
Lead	0.25	0.05
Nickel	0.169	0.08
Zinc	0.73	0.041
Arsenic	0.011	0.004
Bismuth	0.0012	0.001
Tellurium	0.001	0.001
Silica	25.19	27.03
Alumina	2.77	2.66
Lime	3.34	0.78
Magnesia	3.17	1.04
Undetermined— Alkalies, Manganese, Oxide, Phosphoric Acid, Fluorine, CO_2, etc	3.1153	6.2308
	100.0000	100.0000

WEIGHING AND SAMPLING

All the ore received at the works is weighed on beam scales in 2-cwt. drafts; the ore from the company's own mines in parcels of 50 to 100 tons, and purchased ores in parcels according to quantity, but not larger than 50 tons.

In the former case the sample is obtained by placing each twentieth barrow on a paved floor to form the sample pile; this, when completed, is turned over, trenched, and from the sides of the trench about 5 cwt. of ore are removed, and, after mixing, about 1 cwt. is taken from this and passed on to the sampling room.

In the case of purchased ores, which, for the most part, arrive as hand-picked ore broken to about 2½ in. gage, the sampling is performed at a special automatic sampling plant. This plant is so arranged that the feeding takes place at the ore-yard level; the sample is delivered at the bottom of the plant, which is 20 ft. below the ore yard, and all rejects are elevated and delivered into trams running on a tramway above and extending the full length of the yard and bins, so that ore, after sampling, can be delivered to any part of the yard.

The proportion of the parcel taken to the sampling plant is such that about 5 tons are actually put through; thus, if the parcel is about 10 tons, every second barrow passes to the sampler; if it is about 20 tons, every fourth barrow passes, and so on.

The barrows are tipped in regular rotation into a hopper feeding a stone-breaker set to reduce down to about ¾ in. to 1 in. gage. The discharge from the stone-breaker is received in a small tumbling hopper, so arranged that it passes equal weights to the fine crusher and reject elevator alternately. The portion passing on goes through a Marsden fine crusher and a ¼-in. screen, and from this it feeds into a large Clarkson's divider which is set to remove one-tenth and reject nine-tenths; the one-tenth portion passes to a small Clarkson divider which rejects four-fifths and delivers the one-fifth portion, weighing about 1 cwt., into a suitable receptacle, from which it is taken to the sampling room to be completed.

THE SAMPLING ROOM

In this room there are two Fraser & Chalmer's power-driven sample grinders, one grooved for coarse grinding, and the other smooth for fine grinding. Let into the floor is a smooth cast-iron plate about 8 ft. square, and under this is a shallow brick chamber into which live steam can be admitted, so that damp samples, while being worked on the plate, can at the same time be dried and the sifting thus facilitated. The room is also provided with a small rock-breaker for rough special samples and with drying stoves for water-weight determinations.

On being brought into this room the sample is put through the first of the two sample grinders until it passes an eight-hole sieve, the sifting being done by hand on the cast-iron plate referred to. After being thoroughly mixed with the shovels, the chief sampler and his assistant working together, the pile is quartered in the usual manner, and the sample portion again put through the grinder. This operation of grinding, sifting, mixing and quartering is continued, a finer sieve being used each time, until the sample finally passes a 60-hole sieve.

In this condition it is divided into five or six pulp samples with a small Clarkson's sample divider, and each of these is then sealed up; one is forwarded to the assay department, one is handed to the seller's representative, and the others are placed in the storeroom for future use, if required. The works accounts are all based on the ton of 2240 lb. and the wet assay. The method employed for the determination of the moisture was as follows: At frequent intervals during the weighing of a pile, about a shovelful of the ore was taken from the face where shoveling was taking place. The ore thus taken was stored in an ore bag kept buried just below the surface of the pile of ore being operated on. On the weighing being finished for the day, the sample thus taken was removed to the sampling room, where it was crushed, if necessary, to about ¼ in. gage in a small crusher, rapidly mixed with shovels on the iron floor, and quartered down to about 4 lb. From this a portion weighing exactly 1 lb. was taken and dried at a low temperature in pans placed on a hot plate. When no more moisture was given off, as indicated by the dulling of a cold piece of glass held near the surface of the ore in the pan, the ore was allowed to cool somewhat and transferred to the scale pan, the loss in weight thus obtained being entered as moisture. In the case of a pile of ore requiring more than one day for weighing off, there would be in this way a moisture determination for each day's weighing and the results thus obtained would be taken into consideration when making up the water weight for the whole pile.

ASSAY OFFICE AND LABORATORIES

These departments are included in a separate building and comprise one assay room and three laboratories, one for general work, one fitted specially for electrolytic copper determinations, and the other reserved for the analysis of refined copper and any special work. There is also one room serving as a balance room and library. Included in this building are also a storeroom, a room for the small grinding appliances and another room containing the wire-drawing plant.

The assay room is provided with melting and muffle furnaces. The chief points of interest about these are that the ash pits open to the outside of the building and are there provided with air-tight doors which are kept closed except for

cleaning-out purposes. A small opening on the room side, fitted with a slide, provides for the necessary air regulation. By this arrangement the dust and mess which usually accompany the removal of the ashes are avoided. The muffle furnaces are coal fired, and in these not only are the ash pits fitted up similarly to those of the smelting furnaces, but the firing is also done from outside the building.

One peculiarity of the assay department is worthy of note, that though all settlements for ore are made on the basis of the electrolytic assay, a modified Cornish assay is also made on all the ores except those which are received from the Moonta and Wallaroo mines.

The modification consists in so conducting the assay as to produce a "coarse copper" button not so coarse as is usual in working the process, and the fracture of this copper button at once indicates if impurities are present to an extent which brings the ore into the impure class, without the necessity for a more careful analysis. If the button does not show the presence of these impurities, then only is the ore subjected to a careful analysis in the laboratory.

The laboratories are provided with the usual appliances and high- and low-vacuum apparatus for filtration. Steam is supplied from a small low-pressure boiler for heating and evaporating and for making distilled water. The electrolytic determinations are made with platinum cylinders of the usual type, and the current is supplied by sets of Meidinger batteries.

As no coal gas is available, all the gas for heating purposes is supplied by air charged with gasolene vapor, made by a machine set up in a cool cellar in another part of the building, and supplied to the laboratory benches in the same manner as ordinary gas. The lighting is by electric current drawn from the works' generating plant.

On an average the ores treated contain too much sulphur for economical smelting, and a selection has therefore to be made of those which are most suitable for calcining, while the richer classes of ore, those containing the larger percentage of copper and smallest proportion of iron pyrites, are reserved for admixture with the smelting charge, without previous calcination. Oxidized ores with siliceous gangue are treated direct in the roasting furnaces with the matte.

CALCINING PLANT

For calcining the ore two essentially different plants are in use; one for calcining the rough ore and the other for calcining the jigged concentrates and fines. The rough ore so treated contains approximately 10 to 12 per cent. copper, 19 per cent. sulphur, and 30 per cent. silica.

It is treated in burners which are somewhat similar to the ordinary pyrites burners used by sulphuric acid works; they are so designed as to yield a gas containing about 7.5 per cent. by volume of SO_2, which is conveyed by underground flues to the sulphuric acid plant. There are two sets of these burners, each consisting of twelve cells, built back to back, with a central flue for carrying off the gases.

The ore is discharged from railway trucks into two underground bins, and from these it is drawn off into trams, which are hauled by a winch to the top of the burners and discharged into the hoppers placed over each cell. From these it is discharged into the burners by opening a suitable valve.

The calcined ore, containing on an average 5.5 per cent. sulphur, is drawn off at the bottom of the burner and allowed to fall into bins to cool; from these it is removed in trams to the crushing plant. Each cell receives a charge of about 10 cwt. twice in 24 hours. The burners described are capable of treating about 165 tons per week. The labor of charging and working the burners is performed by a man and lad working eight-hour shifts. There are two such shifts in 24 hours, and two periods of four hours each when the burners are left to themselves.

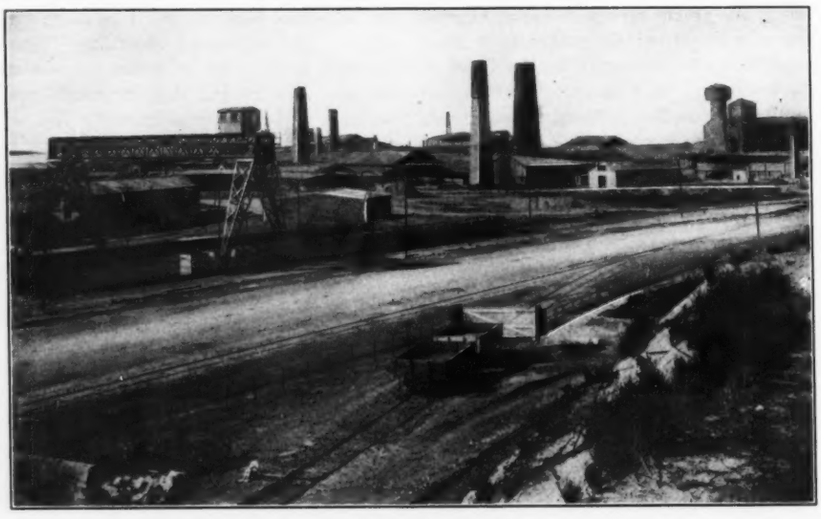
The removal of the burnt ore from the cooling bins below the burners is performed by lads allocated to the crushing plant. After calcination in these burners, the ore passes through a pair of Cornish rolls, set rather wide, so as to crush it to about 1 in. gage, and from the crushing plant it is trammed to the mixing yard, where it is dumped.

MECHANICAL CALCINERS

The jigged concentrates and fines are calcined in mechanical calciners of the Oxland and Hocking type. The revolving tube of these furnaces is 40 ft. long, and 6 ft. in diameter, fitted with a 9-in. firebrick lining and six rows of fire-clay tiles. It is supported on three pairs of friction rolls with a slight decline toward the fire-place end, and is driven by worm gearing so that it makes one revolution in about five minutes. A nest of five of these is erected at a lower level and at right angles to the mixing yard.

Each of these furnaces is fitted with two bins built alongside and discharging on the same level as the furnaces themselves. The ore to be calcined is weighed off into one of the bins, and a suitable mixture of raw ore, calcined ore from the burners and roughly crushed roaster slag, from the second smelting operation, is weighed off into the other.

The calciner tube discharges the calcined ore into a small elevator pit and the mixture of raw ore, calcined crushed rough ore and slag is conveyed from the bin containing it by a traveling belt, which discharges into the same elevator pit which receives the ore from the calciner tube. From this pit the mixture of ores and slag is elevated and discharged into a pair of large hoppers placed on a traveling carriage running on a slightly inclined tramway down to and over the smelting furnaces.



VIEW OF THE SMELTING WORKS

The whole work of moving the ore into the calciner tube from the bin and from the other bin to the traveling belt is performed automatically by suitable feeders. When the smelting furnace is ready for its charge, the hoppers are lowered by means of a winch down the slightly inclined tramway over the smelting furnace, and there discharged into the furnace through suitable openings in the roof. When empty they are hauled back by the winch to their position under the elevator. By this arrangement the ore is discharged hot into the smelting furnace, without any manual labor. There is one such calcining furnace with its accompanying pair of bins to each of five smelting furnaces. They are all driven from one main shaft operated by a pair of electric motors.

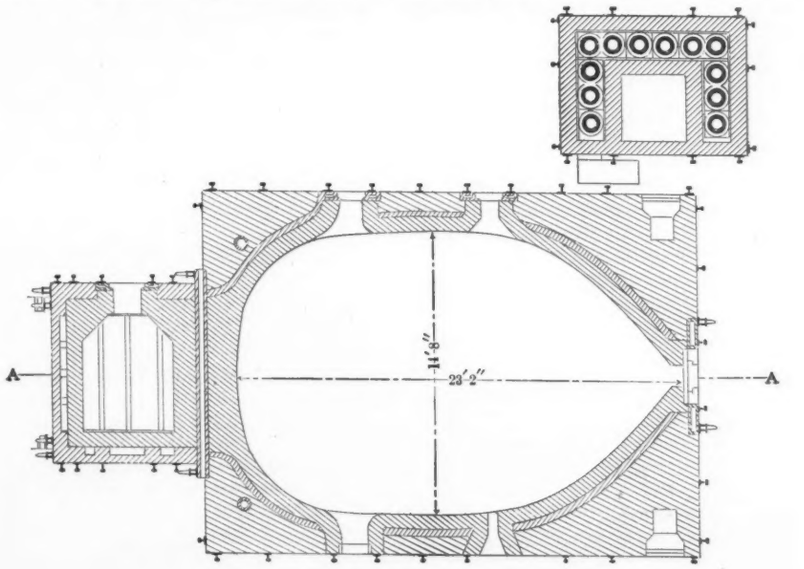
RESULTS OBTAINED

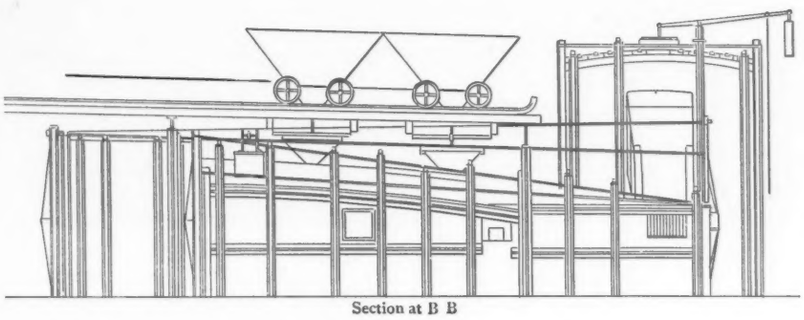
The ore treated in these calcining furnaces contains about 15 per cent. copper

and 20 per cent. sulphur, and by calcination the sulphur is reduced to about 7 per cent. The coal used averages 7 per cent., calculated on the weight of the ore put through; this includes the coal required for the power, each furnace with its gear absorbing about 2½ brake horse-power.

One man working a 12-hours shift attends to each calcining furnace. The work is exceedingly light as there is but a small amount of firing to do, and the other duties consist only in attending to the necessary lubrication of the moving parts. Some little experience, however, is required in order to regulate the heat of the furnace properly.

These furnaces, working continuously day and night with practically no stop, run for nine months, at the end of which period they are put out to enable the masons to make any repairs to the grates and tiles which may be necessary, and the opportunity is then taken to overhaul the machinery and moving parts. The lining, with trifling renewals, lasts about seven years.





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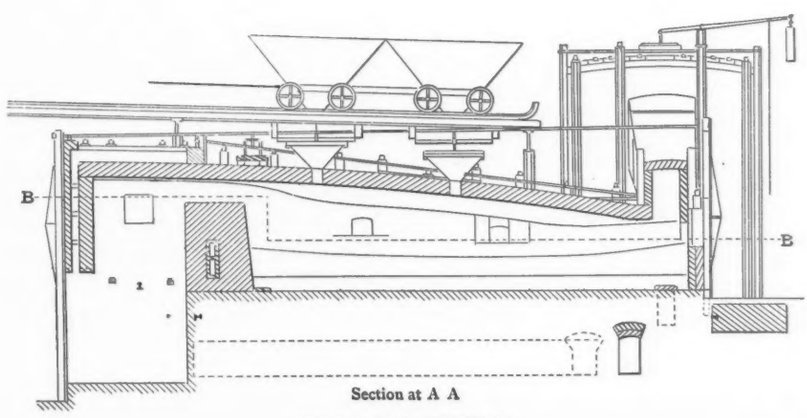

Section at A A

ORE-SMELTING FURNACE

ORE-SMELTING PLANT

The furnaces employed for smelting the mixture of calcined and raw ore are of the reverberatory type, the beds being 23 ft. 3 in. x 14 ft. 9 in. They are provided with two skimming doors, one at the side and one in front, and with a system of flues under the bed and cast-iron pipes in the downtake for heating the air, which is admitted partly under the ash pit, of which the grate is closed by iron doors, and partly through openings in the roof over the fire bridge.

There are six smelting furnaces of the dimensions named, and one half that size. Five of the large furnaces are coupled up direct to the mechanical calcining furnaces. The other large furnace and the small one take their charge direct from the mixing yard.

In the case of these two furnaces the hoppers themselves are hauled by wire rope up a slightly inclined tramway to the mixing yard, where they pass into a trench, so that they are easily filled by wheelbarrows from the various heaps of ore, to form a suitable smelting mixture. The calcined ore for these charges is derived from the burners working on lump ore.

When the hoppers are filled they are lowered down the incline to their position over the charging holes in the roofs of the furnace, and when the furnace is ready, the ore is dropped into it from the hopper. The charge for all the large furnaces is about 8 tons, and for the small one half that quantity. They smelt three charges in 24 hours and consume about 0.38 ton of coal per ton of ore smelted; the large furnaces are worked by two smelters and a laborer in each shift of 12 hours. The ore smelted contains 14 per cent. copper.

The slag produced is of the following average composition:

	Per Cent.
Silica	40.0
Ferrous oxide	42.5
Alumina	6.5
Lime	5.0
Magnesia	3.0
Copper	0.3
Lead	0.11
Nickel and Cobalt	0.18
Zinc	0.20
Phosphoric acid	0.9
Manganese oxide, sulphur, etc., by difference	1.31
	100.00

The chief constituents of the matte are as follows:

	Per Cent.
Copper	51.5
Iron	21
Sulphur	26

The slag and matte as they run from the furnace are received in sand molds. The slag, when cold, is broken up and removed to the slag dump, while the pigs of matte are passed on to the roasting department.

ROASTING

This department is provided with two revolving calcining furnaces, three large

roasting furnaces, the beds of which are 20 ft. x 13 ft. 6 in., and seven smaller furnaces. One calcining furnace serves the three large roasters and the second calcining furnace is connected with the smaller ones.

The method of working here adopted is to charge the roaster furnaces with about one-third raw matte and two-thirds calcined matte. About one-fourth of the matte from the matting furnaces is conveyed direct to the roasting furnaces, while about three-fourths of it is delivered to the calcining furnaces. Each of these is provided with a small crushing plant consisting of jaw breakers and rolls, elevators, screen and small storage bin.

The matte is here crushed to about ¼ in. gage and elevated from the storage bin to the calcining furnace. After passing through the calcining furnace it is elevated, together with a small proportion of oxidized ore, to a storage hopper, from which it is automatically fed into and conveyed by a traveling hopper, which carries it above the row of smelting furnaces and discharges the calcined matte, etc., into hoppers placed over the furnaces.

The whole of the work, therefore, from the time the matte is thrown into the jaw breaker to the time it is distributed to the hoppers over the smelting furnaces, is performed automatically. These matte-calcining furnaces are similar to those used for calcining the ore, except that they have fewer projecting tiles fitted to them.

Each of the calcining furnaces is managed by two men, working in two 12-hour shifts, with the assistance of a lad during the day, working an 8-hour shift. The crushing plant is attended to by three lads, each working 8-hour shifts in succession.

The power required is about 3¾ h.p., which includes that absorbed by the crushing plant, and that needed for moving the calcined matte to the smelting furnaces. About 16 tons of matte are calcined in 24 hours on a consumption of about 1 ton of coal; the sulphur is reduced to about 12 per cent.

METHOD OF OPERATION

When the roasting furnaces are ready for their charge, a proportion of raw matte is first put upon the bed through the side door, with a small quantity of refinery slag, roaster-flue deposit and low-grade precipitate copper, and the charge of calcined matte is dropped from the hopper above the furnace through an opening in the roof.

Originally, the roaster furnaces were entirely charged with raw matte, and when these mechanical calcining furnaces were first introduced, in 1885, with a view to shortening the roasting process, a trial was made for some time with the object of obtaining the copper by what is known as the "direct process," i.e., the regulus was calcined to such an extent that, when melted down, it produced at once metallic copper.

After an extended trial, however, it was found that the time required to smelt the charge and produce metallic copper in this way was considerably greater than when a portion of raw regulus was added to the charge. In this latter case, when the charge was smelted it was in the condition known as white metal, and had then to be blown to produce copper. But, in spite of this, the time required to produce the copper was shorter, as stated above.

The explanation of this seeming anomaly is that the fine calcined matte lies dead on the furnace bottom and the heat does not readily penetrate through it, whereas when some raw regulus is placed on the bed of the furnace it melts easily and floats the calcined fines to the surface, and the heat is better able to penetrate through the mass.

The products of this process are roaster slag, containing about 6.5 per cent. copper, which goes back to the matting furnaces, and "rough copper" with about 98 per cent. copper, which passes to the refinery. Both of these products are cast in sand molds.

The small furnaces work off five charges of 6 tons each per week, consuming 1.5 ton of coal per ton of matte; and the large furnaces five charges of 8 tons each per week, consuming 0.7 ton of coal per ton of matte. In both cases this includes the coal used by the calcining furnace. The small furnaces are worked by one furnace man and a laborer in each shift of 12 hours, and the large furnaces by the same number with extra assistance when charging.

TREATMENT OF BOTTOMS

In this department a certain amount of bottoming is done, one or two furnaces being set apart for this work. The quantity of matte so treated is regulated by the known composition of the ores coming forward, the object being to remove a certain amount of the total impurities present, so that the rough copper delivered to the refinery shall be, as far as possible, of uniform quality.

The gold removed by the bottoms is sufficient to pay for the cost of this additional work. These bottoms are transferred to the gold and silver department, and the bottomed regulus to the other roaster furnaces. The proportion of bottoms aimed at is 5 per cent. of the total copper in the charge. The gold in the bottoms varies from 2 to 6 oz. per ton of bottoms. As the removal of impurities by bottoming is interesting, particulars of a week's work, during which the products were weighed and sampled, are given below. In this case the proportion of copper in the bottoms was 7½ per cent. of the total copper present.

	Matte Charged.	Selected Regulus Produced.	Bottoms Produced.
Copper ..	51.2 per ct.	80.25 per ct.	98.1 per ct.
Nickel...	0.25 per ct.	0.17 per ct.	0.52 per ct.
Zinc.....	0.39 per ct.	0.03 per ct.	0.06 per ct.
Arsenic..	0.006	0.003	0.01 per ct.
Gold.....	0.25 oz. p. t.	6 gr. per t.	3.8 oz. per t.
Silver ...	1.7 oz. per t.	0.9 oz. per t.	3.0 oz. per t.

COAL-STORAGE GROUND

Calculating the impurities on 100 parts copper in each case, we have:

	Matte Charged.	Selected Regulus Produced.	Bottoms Produced.
Copper ..	100	100	100
Nickel...	0.4882	0.2118	0.5300
Zinc.....	0.7616	0.0373	0.0611
Arsenic..	0.0117	0.0037	0.0122

REFINING

The refinery department is furnished with three refining furnaces, two of which are kept at work with the third in reserve. The charge of "rough copper" is about 12 tons and the coal consumed 0.4 ton per ton of refined copper produced. The work is conducted in the manner usual in a plant of this size, the copper being ladled into the molds by hand. The only special point to which attention should be called is that the copper cathodes from the electrolytic

refinery in connection with the gold and silver department are added to the charge.

The following are the most usual forms in which the refined copper is cast: Ingots, weighing 14 lb.; "medium cakes," weighing about 40 lb., made specially for the Indian mints at Calcutta and Bombay, and for the Cossipore shell foundry; and "cakes" weighing one hundredweight.

As a check on the work of the refinery, the chief chemist makes an electric conductivity test of each furnace charge, and unless this is satisfactory, the charge, after ladling, is put on one side, and an analysis of the copper is then made to determine whether the defect is due to an excess or deficiency of oxygen, or the presence of too high a proportion of nickel. If the latter is found to be the cause of the low conductivity, the copper is sent back to the roasting furnaces, and put through again in small quantities at a time with the other charges.

If the examination shows that the fault lies in the quantity of oxygen present, the charge is passed through the refining furnace a second time. It is, however, not often that the copper is thus condemned. The management has prided itself on keeping the quality of the copper as uniform as possible, and any charge which departs from this uniformity is treated in the manner described.

For the electric conductivity test during the second or third round of the ladling a special test piece is cast, and this is carefully drawn down by the smith to a short rod about 9 in. long by ¼ in. diameter. One-half of this is then drawn down on a wire-drawing bench, with occasional annealing, finishing through a sapphire die to a wire about 0.025 in. diameter. After a final annealing and cleaning the electrical conductivity is carefully determined against a standard coil. The second half of the rod is kept in that form after being labeled and is available for future reference. The electric conductivity of Wallaroo copper is kept at about 88 per cent.; if it falls below 86 per cent., it is not passed.

The following may be taken as a representative analysis of Wallaroo copper:

	Wallaroo.	Quincy.	Mansfield.
	Per Cent.	Per Cent.	Per Cent.
Copper	99.6648	99.7975	99.6332
Iron	.0053	.0031	.0049
Sulphur	.0005	.0035	.0039
Silver	.0063	.0692	.0228
Gold	.0013	.00002	Nil
Oxygen	.0997	.0862	.1327
Lead	.0115	.0038	.0312
Nickel	.1764	.0106	.1480
Zinc	.0134	.0023	.0075
Arsenic	.0022	.0208	.0118
Tellurium	.0030	Nil	Nil
Bismuth	.0018	.0001	.0003
Insol. residue	.0038	.0029	.0037
Totals	100.0000	100.00002	100.0000

The electrical conductivity of this copper was 88.63 per cent. The results obtained by the same method of analysis for two well known brands are appended for the sake of comparison.

CHIMNEYS AND FLUES

The ore-smelting furnaces are for the most part connected by an underground flue to a chimney 100 ft. high above the ground line by 7 ft. 6 in. square inside at the top, while a few of them have each a separate chimney 60 ft. high by 3 ft. 8 in. square at the top. The roasting and refining furnaces and the matte-calcining furnaces work into an underground flue connected with a chimney 15 ft. square at the top, which is 120 ft. above the level of the furnace floor.

The flue connecting the furnaces with the chimney is about 1100 ft. long and has a cross area of 60 sq.ft. The advantage of long and large culverts in collecting flue dust is shown by the following figures, which give the weights, assays and total copper recovered from these flues in the course of a year.

COMPOSITION OF DUST FROM FURNACE FLUES

	Weight of Deposit.			Average Percentage of Copper.	Total Fine Copper.			
	Tons.	Cwt.	Qr.	Per Cent.	Tons.	Cwt.	Qr.	Lb.
Ore-smelting furnaces	35	1	3	6.04	2	2	1	15
Roasters, main culvert and chimney	518	4	0	36.00	186	16	1	25
Refinery culvert	67	4	2	50.10	40	7	3	27
Totals	620	10	1	36.96	229	6	3	11

It will be noted that the copper in the flue dust from the ore furnaces in comparatively unimportant, but the quantity obtained from the culvert into which the roasting and refining furnace work is considerable.

The total recovery of copper, based on the wet assay of the ores, is 95 per cent.

FUEL

The total coal consumed, including that required for locomotives and crushing plant, is 0.87 ton per ton of ore smelted. The coal used is "small" coal obtained from what is known as the northern coal field of New South Wales, the pits being near Newcastle, from which port the coal is shipped to Wallaroo. A representative analysis of the coal used is as follows:

	Per Cent.
Moisture	2.5
Volatile hydro-carbons	34.5
Fixed carbons	52.0
Ash	11.0
	100.0

As the consumption for all departments at the works is about 1000 tons per week, provision has to be made for storing a considerable quantity, and for taking delivery rapidly as it is discharged from the steamers, which usually carry cargoes of about 2000 tons.

For the purpose of storage a piece of ground has been laid out and is served by a gantry of 80 ft. span. The coal is brought from the ship's side to this storage ground in railway trucks, each of which has two iron-bound square wooden boxes placed upon it, each containing 2 tons 13½ cwt. of coal. A train of trucks is hauled up a slight incline and there left, the locomotive returning with empties to the ship's side. The trucks are moved one by one down the incline until they come under the gantry. The lifting gear is then attached to trunnions on the sides of each box, which is lifted off the truck, hoisted, and traversed at the same time, until the spot is reached over the heap at which it is desired to empty it. On pulling a trigger, the box revolves on the trunnions and discharges the coal, after which it rights itself automatically and is replaced empty on the truck. The plant is capable of unloading 80 tons of coal per hour. As the heap of coal increases in length, the gantry is moved forward. All the motions are electrically driven by current derived from the work's mains.

The gantry is worked by one man, who controls all the movements, with a laborer and lad to handle the trucks and boxes; the cost of this is ½d. per ton, which includes cost of current, but not depreciation.

During the time a vessel is discharging, the furnaces are supplied direct from the ship's side, and at other times by reloading into trucks running on lines laid permanently on the yard floor upon which the coal is stored. The average cost of coal placed alongside furnaces is 13s. 6d. per ton.

LIGHTING AND POWER

Lighting and power for all the machinery except the crushing plant is provided by an electric installation on the 3-wire system, deriving direct current from a central station in the works. For this purpose the generating plant consists of two Westinghouse 56¼-kw. dynamos suitably connected, so as to generate current at 420 volts on the outside wires and 210 on the neutral wire.

The current is conveyed through the works by overhead bare copper conductors, insulated cables only being used on branch leads passing into the buildings or sheds. Current is also supplied in bulk from this station to the town of Wallaroo for lighting purposes. The cost per B.t.u., including 10 per cent. on the capital outlay, is 1.2d.

FIRE BRICKS AND REFRACTORY MATERIALS

Two classes of brick are used, silica and clay respectively. These are partly made at the works from material obtained in the State and partly imported. For some purposes the locally made bricks of both classes, which are very much cheaper, are

substituted for the more expensive imported bricks.

For making fire bricks on the spot a small plant is installed, consisting of crushing and mixing machinery, with brick-molding machine and press for making square bricks, together with a firing kiln. The special bricks and tiles are hand molded.

The furnace bottoms are formed of sand found in the neighborhood, which is admirably suited for the purpose, and which has the following composition:

	Per Cent.
Silica	93.3
Ferric oxide	1.6
Calcium carbonate	4.0
Organic matter and moisture	1.1
	100.0

The California Miners' Association

SPECIAL CORRESPONDENCE

The California Miners' Association recently elected William C. Ralston, president; C. H. Dunton, vice-president, and John J. Hendy, treasurer. Mr. Ralston is a mining engineer, with much practical experience in both quartz and gravel properties, and is now a mining stock and bond broker in San Francisco. Mr. Dunton has charge of the slate quarries at Slatington, El Dorado county; and Mr. Hendy is connected with the Hendy Machine Works, of San Francisco. President Ralston has appointed a new executive committee for the year, which will have charge of the affairs of the association until the annual convention next fall. In selecting this committee he has omitted all ex-presidents and former officials, and chosen men prominently connected with different branches of the mining industry, the object being to put the association in closer touch with these branches than has heretofore been the case, and to give its work a wider scope. Originally organized as a defender of hydraulic mining interests, which are now of comparatively small importance, it has become necessary to reorganize the association in some degree, in order to keep it in touch with live interests affecting the mining industries.

The new executive committee just appointed by President Ralston is composed of the following gentlemen: Charles G. Yale, chairman, one of the original organizers of the association 13 years ago, and at present connected with the ENGINEERING AND MINING JOURNAL and the Geological Survey; Edward Coleman, a San Francisco capitalist, whose fortune was established by operating the famous Idaho mine, in Grass Valley, and who is still largely interested in quartz and gravel mines; C. W. Cross, the mining attorney, for many years identified with the litigation connected with hydraulic mining suits; Ross E. Browne, mining engineer, long identified with the drift-mining interests of Placer county, and for the past few years a resident of Johannesburg, South Africa; Thomas Clark, manager of the River Hill Mining Company, of El Dorado county; Lewis T. Wright, general manager of the Mountain Copper Company of Shasta county; S. B. Christy, professor of mining in the University of California; E. B. Braden, manager of the Selby Smelting Company, of San Francisco; T. A. Rickard, editor of the *Mining and Scientific Press;* B. M. Newcomb, general manager of the New Idria Quicksilver Mining Company and other California quicksilver mines; Louis Rosenfeld, of John Rosenfeld's Sons, manager of the Eagle-Shawmut Gold Mining Company and other quartz mines in the State; F. W. Bradley, mining engineer, largely interested in dredge and quartz mines and a trustee of the State mining bureau; Frank H. Buck, of the Associated Oil Companies of California; Col. George Stone, manager of extensive cement works, and interested in gold quartz mines; George W. Starr, manager of the Empire mines of Grass Valley, one of the largest quartz gold producers in the State. J. D. McGilvray, representing the building-stone quarrying interests; Andrew Carrigan and Alexander Hamilton, hardware and mining machinery men; Louis Sloss, of the Northwestern Commercial Company, of Alaska, and owner in the Lassen Mining Company, the El Dorado Dredging Company, and the Boss Copper Company; J. J. Hamlyn, president of the Dredge Miners' Association, and R. Gilman Brown, mining engineer, former manager of the Standard Consolidated Mining Company, of Bodie, Mono county, and now president of the Brunswick Consolidated Mining Company, of Nevada City, Nevada county.

This should make an exceptionally strong committee of active men all having the advancement of the mining industry at heart. They hope to restore the influence of the California Miners' Association, and make it again the power for good that it was.

Pig-iron Production

In our last issue the general figures of pig-iron production for the United States, as given by the American Iron and Steel Association, were given. To these are now added some interesting details from the report. The output, classified according to fuel used, was as follows, in long tons:

	1905.	1906.	Changes.
Coke	20,964,937	23,313,498	I. 2,348,561
Anthracite and coke,	1,644,424	1,535,614	D. 108,810
Anthracite alone..	30,091	25,072	D. 5,019
Charcoal	352,928	433,007	I. 80,081
Total	22,992,380	25,307,191	I. 2,314,811

Under coke furnaces are included the very few which use raw bituminous coal. The fact that 92.1 per cent. of our iron is made with coke—not counting the proportion of coke used in connection with anthracite—shows the predominant importance of that fuel in iron metallurgy.

In addition to the 300,500 tons of spiegeleisen and ferromanganese reported, there were made in 1906 a total of 142 tons of ferrophosphorus, a decrease of 1101 tons from 1905; and 5000 tons of bessemer ferrosilicon, an increase of 2250 tons. The special low-phosphorus iron, included under bessemer pig in the statement, was 228,769 tons in 1906.

The production of all kinds of pig iron, by States, was as follows, in long tons:

States.	1905.	1906.	Changes.
Massachusetts and Connecticut	15,987	20,239	I. 4,252
New York	1,188,068	1,552,659	I. 354,591
New Jersey	311,039	379,390	I. 68,351
Pennsylvania	10,579,127	11,247,869	I. 668,742
Maryland	332,096	386,709	I. 54,613
Virginia	510,210	483,525	D. 26,685
N. Carolina, Georgia and Texas	38,699	92,599	I. 53,900
Alabama	1,604,062	1,674,848	I. 70,786
West Virginia	298,179	304,534	I. 6,355
Kentucky	63,735	98,127	I. 34,394
Tennessee	372,692	426,874	I. 54,182
Ohio	4,586,110	5,327,133	I. 741,023
Illinois	2,034,483	2,156,866	I. 122,383
Michigan	288,704	369,456	I. 80,752
Wisconsin and Minnesota	351,415	373,323	I. 21,908
Missouri, Colorado and Washington	407,774	413,040	I. 5,266
Total	22,992,380	25,307,191	I. 2,314,811

Of the output in 1906 Pennsylvania supplied 44.5 per cent.; Ohio, 21.1; Illinois, 8.5; Alabama, 6.6; New York, 6.1 per cent. No other State made as much as 1,000,000 tons. Illinois last year made the largest proportional increase.

The whole number of furnaces in blast on Dec. 31, 1906, was 340, against 323 on June 30, 1906, and 313 on Dec. 31, 1905. The number of furnaces in blast at the end of 1906 was larger than at the close of any year since 1889, when 344 furnaces were active. At the close of 1906 there were 89 idle furnaces, as compared with 111 idle furnaces at the close of 1905. The number of furnaces actually in blast in the second half of 1906 was 374, as compared with 361 in the first half. In 1905 the number in blast during the last half of the year was 349, against 334 in the first half.

On Dec. 31, 1906, there were 27 furnaces in course of erection and 5 furnaces were being rebuilt. Of the building furnaces 2 were located in New York, 11 were in Pennsylvania, 2 were in Alabama, 3 were in Ohio, 5 were in Indiana, 2 were in Illinois, 1 was in Wisconsin, and 1 was in Colorado. All these furnaces when completed will use coke or mixed anthracite coal and coke for fuel. Of the 5 re building furnaces 1 was in Pennsylvania, 2 were in Alabama, 1 was in Illinois, and 1 was in Washington. When rebuilt 4 furnaces will use coke for fuel and 1 furnace will use charcoal. In addition there were 23 furnaces projected and one furnace partly erected on Dec. 31. If built all the projected furnaces will use mineral fuel.

CENTRIFUGAL PUMPS

Their Theory, Design and Performance

BY RICHARD C. WILLIAMS,*

The principle of reversibility of the hydraulic turbine, the application of its theory to a design in which work would be put in instead of being taken out, the construction of the actual machine in which water flows up instead of down, being almost an exact reversal of design of the turbine, has taken many years to perfect and has been the Waterloo not only of many individual inventors but of many large engineering companies.

Contemporary with the commencement of the development of the centrifugal pump into a machine which would be held in respect when pumping units were under consideration, came the introduction of electric motors, direct connected to every kind of machinery where convenience was of importance. Though with the earlier types of slow-speed reciprocating pumps motors were used, the gearing was a source of constant annoyance and repair. With the design of high-speed reciprocating pumps abroad, with valves actuated by positive mechanism, this condition was improved somewhat, but its introduction in this country, for mine drainage at least, has for several reasons, which will be mentioned later, not yet come about. These high-speed reciprocating pumps have been successfully operated from 160 to 300 r.p.m., according to the size and head, and when under test showed remarkable efficiency as to power consumption.

For moving large quantities of water against considerable head the high-lift turbine pumps, and particularly those of the multi-stage type, where a culminative pressure is provided without prohibitive rotative speeds, are being extensively used. For mine drainage in particular they bespeak good recommendations, for the cost of foundation and excavating room for them is less than for a reciprocating pump of similar capacity, because the turbine pumps operate at a very much higher speed, and hence the pumping unit is of a correspondingly smaller size. Also, since the flow is continuous and uninterrupted, there is no water hammering in the pipes and no cumbersome air vessels are required.

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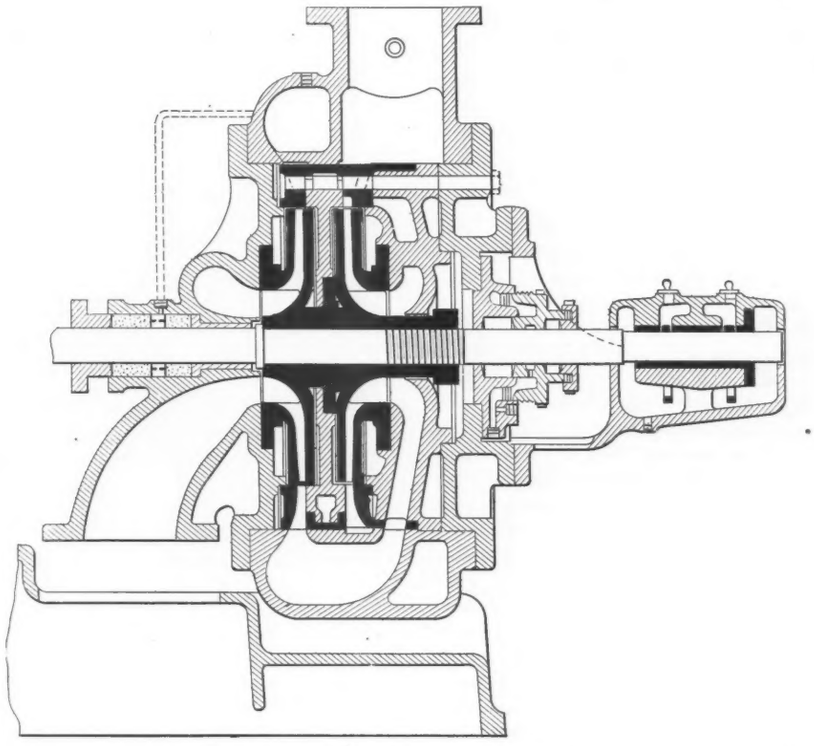
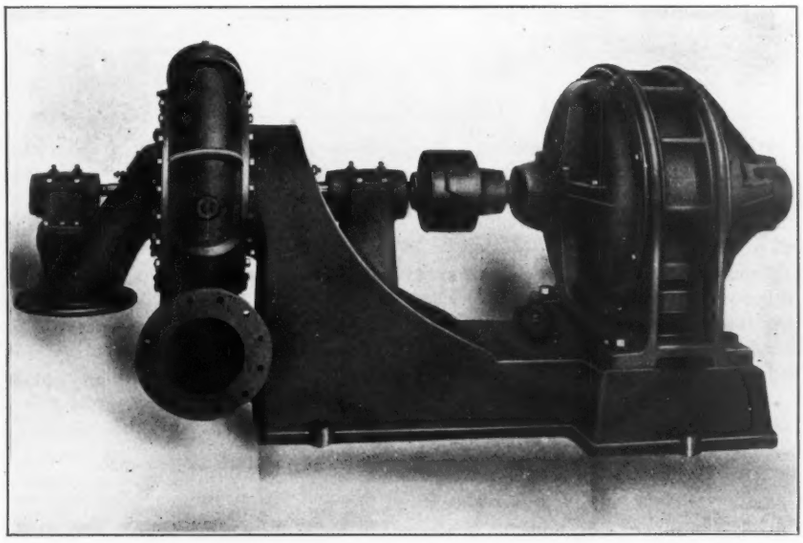


SECTION OF BUFFALO TWO-STAGE TURBINE PUMP



SINGLE-STAGE, ACID-RESISTANCE, CENTRIFUGAL PUMP

COMPARISON OF RECIPROCATING AND CENTRIFUGAL PUMPS

To further draw a comparison between reciprocating, direct-acting and centrifugal pumps, we may note three chief variables—head, volume and speed. For any given constant head the volume and speed are proportional, though not as simple functions. A direct-acting pump, however, has a capacity or volume proportional directly to the number of revolutions. For any constant volume the speed required to operate the pump is a function of the square root of the head, this being deduced from the formulas for centrifugal action and $V = \sqrt{2gH}$, or the law of falling bodies. If we consider the speed constant and note the effect of changing volume and speed, we find that the relation, though similar to that occurring with constant head, a greater change takes place in the volume for a change of head, and also that the variations are in the opposite direction. While the formulas are readily developed mathematically, the coefficient must be experimentally determined for a maker's particular design of pump.

If u_2 = peripheral speed of runner in feet per second;

H = head and V = velocity in feet;

$u_2 = \sqrt{bH + aV^2} + aV$, where a and b are constants;

and also,

$$H = 0.031\,K\,(u^2_2 - u_2\,v\,cot.\,\alpha)$$

in which K is a constant and α the angle of the blade at the circumference of the impeller.

One of the most important considerations limiting the speed of the pump is the quality of the water being handled, i. e., if the water be gritty or contain solid matter of any nature, we cannot select a moderate speed owing to the excessive wear which would result if the pump were running at as high speed as possible with clear water. While a relation between the capacity and head for most efficient operations is hard to express in a general way, it has been stated that at ordinary speeds the best results are secured when the number of gallons per minute handled is equal to the feet head pumped against. Where quantity only needs to be changed to obtain the best efficiency, the outlet may be partially closed.

DESIGN OF CENTRIFUGAL PUMPS

Two distinct types of pumps are in general use, the more common or volute type, being for the lower heads, and where maximum efficiency is not essential; the second or turbine type, is used wherever high heads and maximum efficiency are required. In general, it may be said that the turbine pump will require about 10 per cent. less horse-power for a given head and water quantity than the volute pump under the same conditions. Either type of pump may be built to compound two or more stages, but it is an almost universal practice to use only the turbine type for compounding since this design, aside from giving somewhat higher efficiency, lends itself most readily to a compact and mechanical arrangement.

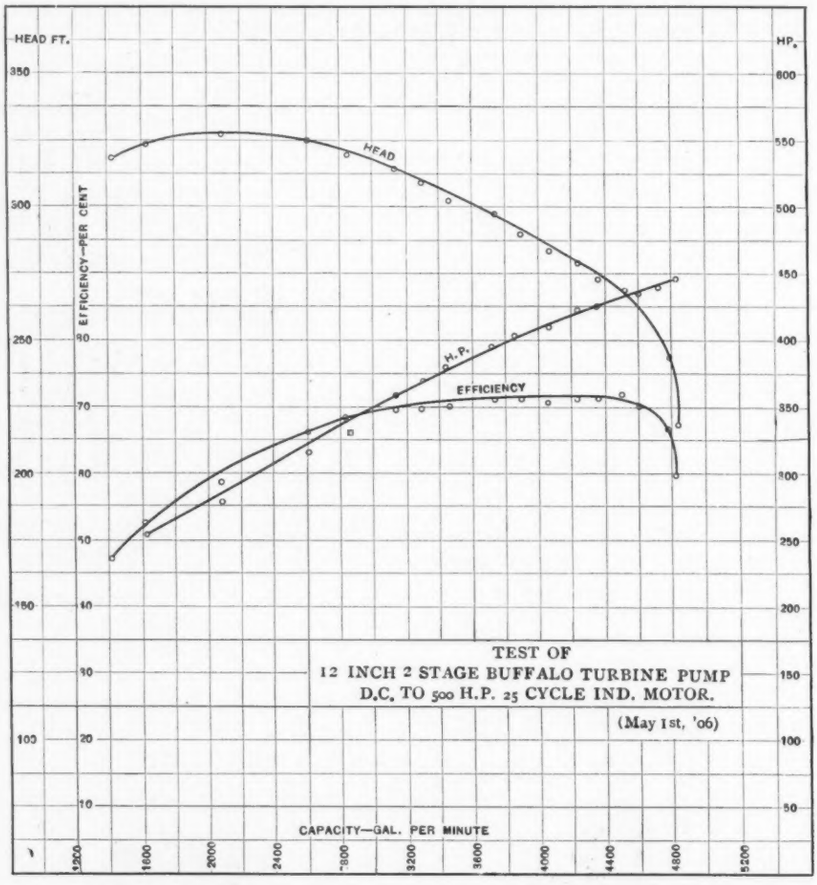
All types of centrifugal pumps possess two essential elements: First, a rotating waterway or impeller; second, a stationary waterway contained in the outer shell. The water enters the impeller at the center, passes between radial vanes, and is discharged at the periphery of the impeller. The energy imparted to the water in its passage through the runner is in two forms, potential and kinetic, i.e., pressure and velocity. The pressure is due to the action of the centrifugal force of the rotating column of water contained between the vanes, and the velocity is practically equal to the peripheral travel of the runner.

If the water were discharged from the impeller directly into a large chamber, the efficiency of the pump would be very low, as the kinetic energy or velocity would be entirely lost. To utilize the greater portion of this kinetic energy or velocity, a throat and volute, or a diffusion ring, is used. These form the essential features of the stationary waterway. In the volute pump the kinetic energy is converted into static, that is, from velocity to pressure by the use of a throat or expanding passageway, leading into a volute shell, which has a cross-section increasing in an arithmetic ratio up to the full area of the pump discharge. In some designs the throat is omitted water discharging directly from the impeller into the volute. However, it has been found that a considerable increase of efficiency is secured by the use of a throat, and that the form of the throat is of great importance. In the turbine pump this conversion is accomplished by the use of a diffusion ring, which consists really of a series of inverted nozzles, which provide a gradually expanding area at a correspondingly decreasing velocity and increasing pressure.

DESIGN OF RUNNER

Two types of runners are used, the open and the closed. In the open runner one or both sides of the waterway are formed by the stationary side plates of the pump. This type of runner is open to the objection of excessive friction and slippage between the vanes of the impeller and the stationary side plates, and is little used in modern pump design. The closed runner has the waterway entirely inclosed between the sides of the rotating impeller. Slippage between the discharge and suction is prevented by a collar on the impeller, fitting into a sleeve on the side plate.

As the water enters the runner through the inlet at a very low velocity, and is rapidly accelerated to a very high velocity, it is evident that the entrance must be very carefully designed; otherwise there will be a serious loss in efficiency due to shock. On this account the area of the waterway and the angle of the blades at the inlet are very carefully proportioned for every speed of rotation and water quantity, the angle of the blades being such that there shall be a minimum shock at entrance to the impeller. The form and curvature of the blades are not so material after the water has passed the inlet. However, it is usual to so design the curvature with respect to the area of the waterway as to secure a nearly constant acceleration from the point of inlet to the periphery. The blades may either be curved forward or backward at the periphery, and at any practicable angle. This curvature, when the waterways are properly proportioned, does not greatly affect the efficiency, but alters greatly the characteristics of pump performance with respect to head and capacity. For example, it is possible to so design the curvature of the blades that there will be a constant or even increasing head with increasing capacities, or on the other hand we can secure a rapid decrease of head with increase of capacity and a nearly constant or even decreasing power consumption with increased capacity.



THEORY OF PERFORMANCE

Without going into the complicated derivation we will merely state the general formula covering the action of centrifugal pumps.

The diagram on page 332 shows the velocities entering into the theoretical formula for centrifugal-pump performance.

u_1 is the linear velocity in ft. per sec. at the heel of the runner blade or at the inlet, i.e., $u_1 = \pi d_1 n$ where d is the diameter of the inlet opening in the runner, and n is the number of revolutions per sec.

u_2 is the peripheral velocity of the runner in ft. per sec.

v_1 is the radial component of the velocity of the water at entrance to runner in ft. per sec.

v_2 is the radial component of the velocity at the periphery in ft. per sec.

w_2 is the actual velocity of the water in ft. per sec. as it leaves the periphery of the impeller.

α_1 is the angle of the blade at the inlet.

α_2 is the angle of the blade at the periphery.

The formula for a head given by a theoretically perfect pump is

$$H = \frac{u^2_2}{2g} + \frac{(u_2 - v_2 \cot. \alpha_2)^2}{2g} + \frac{v^2_2}{2g}.$$

This formula is easily simplified to give

$$H = \frac{(u^2_2 - u_2 v_2 \cot. \alpha_2)}{g}.$$

The theoretical head, however, is reduced from several causes, the chief of these being:

First, loss by shock on entrance to the runner;

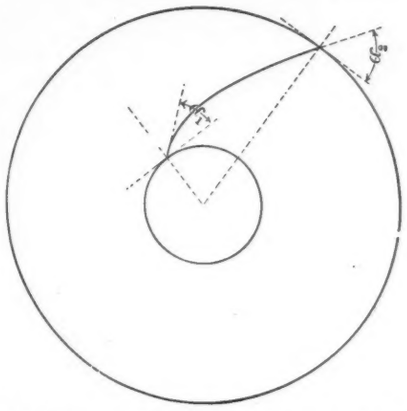
and the theoretical head is usually expressed by the coefficient e which is termed the manometric efficiency. This is found to remain nearly constant through the ordinary range of pump performance. Thus, we have the formula for the actual head given by a pump

$$H = \frac{e}{g}(u^2_2 - u_2 v_2 \cot. \alpha_2).$$

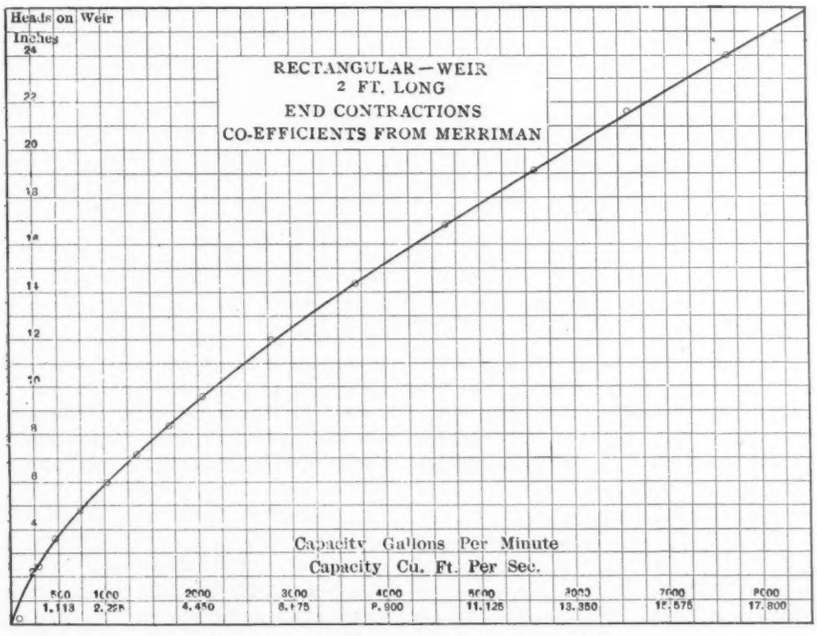
The coefficient e may vary from 50 per cent. in a small or poorly designed pump to 75 per cent. in the best designs.

MECHANICAL EFFICIENCY

The mechanical efficiency of a centrifugal pump theoretically should be less



ANGLE α. LARGE CIRCLE SHOWS DIAMETER OF RUNNER, SMALL CIRCLE SHOWS DIAMETER OF INLET



RESULTS OF TEST—HALF-MINUTE READINGS

Second, friction within the runner passages;

Third, loss by shock and imperfect diffusion on leaving the impeller.

Fourth, friction in the shell and stationary water passages.

These losses must be determined experimentally for every design of pump.

The relation between the actual head and the theoretical head is usually expressed by the coefficient e which is termed the manometric efficiency. This is found to remain nearly constant through the ordinary range of pump performance. Thus, we have the formula for the actual head given by a pump

$$H = \frac{e}{g}(u^2_2 - u_2 v_2 \cot. \alpha_2).$$

The coefficient e may vary from 50 per cent. in a small or poorly designed pump to 75 per cent. in the best designs.

MECHANICAL EFFICIENCY

The mechanical efficiency of a centrifugal pump theoretically should be less than the manometric efficiency, since aside from the internal losses there are the external losses due to friction of the water on the outside of the runner and friction of the stuffing boxes and bearings. This efficiency, like the manometric efficiency, can only be determined by actual test.

The test of a centrifugal pump direct connected to an electric motor at the works of the Buffalo Steam Pump Company is simple in that but a small amount of time is required to set up the portable weir used for the service, connect the motor with the switchboard and attach pressure gages.

In the test herewith given of a Buffalo 12-in. 2-stage turbine pump direct connected to 500-h.p. 25-cycle induction motor, all instruments used were carefully calibrated and were in perfect condition. The results plotted to give the curve are averages of half-minute readings. The gage used to measure head pumped against was made by the Standard Gage Company, and was equipped with a 12-in. dial graduated to read in feet head.

Calibration of this gage with a Crosby dead-weight tester revealed the fact that there was a positive constant error of 6 ft. in the head indicated, i.e., the gage indicated 6 ft. or 2.6 lb. too much.

The power used was taken on a Thompson recording wattmeter, which had been standardized by the Cataract Power and Conduit Company, and was found to have a formula

$$kw. = \frac{720 \times R}{S},$$

in which R equals revolutions of dial; S, seconds time; and 720, coefficient of calibration.

The head pumped against was regulated by means of a valve on the discharge pipe of the pump.

The volume of water pumped was measured by means of the portable weir mentioned. In this there is located a set of baffle plates to bring the surface of the water passing over the weir to a smooth condition, and to the same level across the crest. The computation for quantity was made by Francis' formula allowing for the coefficient of end contraction for a rectangular weir 2 ft. long, which Merriman gives.

The whole pumping unit, i.e., motor, pump and bed-plate, weighed 22 tons.

The Rotary Cement Kiln in England

A London correspondent of the *Cement Age*, says:

"Referring to the rotary process, it may be interesting to record the advance in this direction to date. By the end of this year 93 rotary kilns will have been erected, about half of which are German make, and which are, as yet, generally considered the best. These are mostly 98 ft. in length by 6 ft. 7 in. diameter, and turn out of the wet process over 2500 bbl. per week of 168 hours, on a consumption of 25 to 30 per cent. of fuel. Some English makers, at last, however, are coming to the front with kilns to their own designs, 130 ft. long by 7 ft. 6 in. diameter, with which they expect to get 3000 bbl. under the same conditions.

FIRES IN COAL MINES†

The Warrior Run Fire—Causes and Methods of Attack

BY R. V. NORRIS *

Early in August of 1906 a very peculiar accident occurred at the Warrior Run collieries of the Lehigh Valley Coal Company. Along the line of the up-throw on the surface, there were a number of houses; a woman went into the cellar of one of these to get provision, and was killed by an explosion of fire-damp, the resulting fire destroying the dwelling. In the mine a pump man was found dead in the tunnel. (See Fig. 3.) The colliery had always been non-gaseous, and a very severe general squeeze was in progress; a concussion had been felt, and it was believed that an explosion of gas had occurred.

In the course of a few days they began to smell smoke, and finally determined that there was a fire somewhere in this territory, and started to investigate. The examination had been made as far as the door in the third left tunnel; no one had been through that door, the ventilation had been upset somewhat by the squeeze, and there was a large amount of fire-damp in the colliery. When a consultation was called of all the officials of the company, the mine officials were satisfied that the fire was on the third left, near where the man had been killed, and that he must have met and fired the gas when he went through the door. While local mine officials held to this view, the higher officials could not see it from that standpoint; they argued that the fire in a week would certainly have been out to the fan shaft in the main return.

They believed from an analysis of the gases that there was not enough carbon dioxide for the fire to be in this location. The mine foreman was extremely anxious to pull down the door in the third left, and go in for an examination to see if there had been an explosion. We all felt that such a cause was suicidal, for if the fire was in the third left, access of air would surely increase it, and it was eventually decided to seal up the mine, as shown in Fig. 3. The tunnels from the back basin were first closed, and then the air shaft was sealed off at the fan.

A partial record of the readings and analyses made in connection with this fire are given in the following table:

In this case we analyzed the gases taken from close to the fan with an Orsat apparatus. A very clever Jap assistant, Mr. Hachita, made all the analyses.

ACTION OF THE GASES

We sealed off the mine at 11:14 a.m. on the 15th. The CO_2 ran up slowly at first and then jumped to a maximum hight within a few hours. The carbon monoxide analysis was interesting, as we never found over 0.4 per cent., and from this fact I am satisfied that the fire was in the lower part of these workings, and cut off by the squeeze.

Another great surprise was the way the marsh gas CH_4 ran up to 43 per cent. Of course that might be accounted for by its very light specific gravity. The oxygen ran down to 1.2 per cent. The normal mine air in the region is as follows: CO_2, 1/10 to 4/10 per cent.; CO, 2/10 per cent.; CH_4, 2/10 per cent.; O, 20.3 per cent. We felt that when this oxygen got down to nearly 1 per cent. we had the fire out. During the time the mine was closed the lower levels were flooded by sending water into a bore hole, the water level finally reaching the point indicated.

The mine was only kept closed until December 7 below the third left tunnel. At that time the workings were opened and the fire found entirely extinguished. On reopening, the tunnel between the E and F, veins were found tightly blocked by falls; the F seam showed evidence of a gas fire—great heat and very little ash. This fire broke out again with access of air, and it seems probable, in view of this fact, that the explosion was actually in the F vein on the third lift, but that the products of combustion only reached the return by passing downward through crevices in the separating rock, as the tunnel was securely closed. There may also have been a second and deeper fire which supplied the wood smoke noticed, but that cannot be determined until the water is pumped out. It was evident that the pump man could not have fired the gas, and he was probably killed by the concussion and by the fall of the door under which his body was found.

Near where the pump man's body was found the rock of the tunnel showed traces of fire; there were no such traces in the coal anywhere around there, so it seems possible that there was a feeder of gas on fire in the rock at that point.

The temperature was never excessive. Eighty-six was the highest record we had, and it was 83 when we took our last measurements.

WATER-GAGE READINGS

The normal water-gage, you will note, was 1.48 in.; when the fan was stopped and the mine sealed, the water-gage was

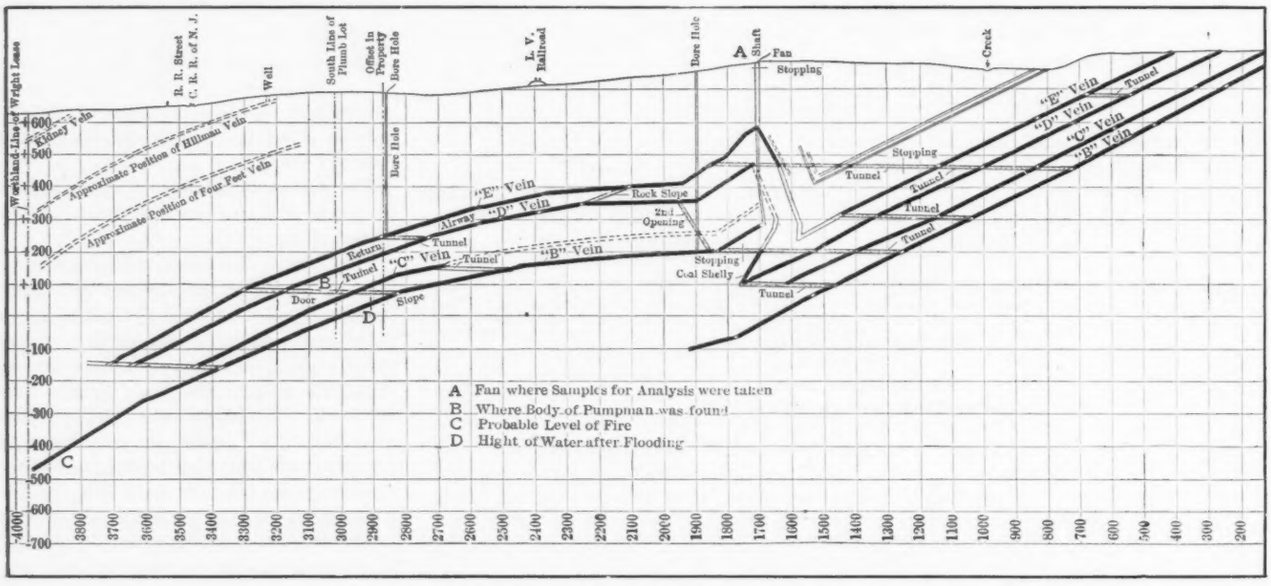


FIG. 3. CROSS SECTION OF COAL MEASURES, WARRIOR RUN, PENN.

†A portion of a lecture delivered before the students at Columbia University, revised by the author, who has also made some additions to the original. The first part of the lecture was published in the JOURNAL of Feb. 9, 1907.

*Consulting engineer, Wilkes-Barre, Penn.

½ in. and then ran up with the heated air to 1 in., afterward cooling off again to the normal ½ inch.

A fact in this connection which I hope someone can explain is this: The water-gage at the top of the fan shaft remained plus ½ in.; the water-gage in the stopping in the lower tunnel from the back basin persisted in remaining minus ½ in., showing that the air would, if permitted, flow in through this stopping. The only explanation that I can make is that the cooling of the air in the mine made a partial vacuum below, while the hot gases gave a pressure at the fan.

In opening the mine we were up against a very awkward problem, as there was 40 per cent. of fire-damp in the air at the fan. The fan stopping was first opened next lift. By damming at the foot of the shaft and stopping the water hoist we were able to raise the normal water of the colliery sufficiently to run into this slope; it was flooded up to about 100 ft. vertically above the known elevation of the fire, and the water was left in for four months.

The examination to determine whether enough water was in was a delicate one: We had to ferry from the foot of the shaft, because to raise the water over the head of the slope it had been necessary to erect a dam at the shaft which continued to an underlying seam, and then got in to the slope. We feared an explosion at any moment, because for several days there had been a series of explosions from the fire, though none for a week previous to the examination. On the way into the very bad fire in the Red Ash seam of the Avondale colliery. This was up near the crop far above water level in old workings where the seam was about 18 ft. thick, and the fire got a very good start. It covered eventually some ten acres of the workings, and all efforts to put it out (there was no water) were unavailing; finally the Lackawanna authorities opened all around the fire and filled the space solidly with clay, actually inclosing the fire with a clay wall and leaving it there. No trouble has been experienced since then.

Another means of attacking a fire that has been used quite frequently is to put a bore hole into the workings and flush the finest culm or sand into the mine and around the fire.

This method was used by the Lehigh Valley Coal Company where a fire in abandoned connecting workings was threatening one of their collieries; they put a series of holes down into the seam, which was on a considerable dip, and flushed the workings full of waste culm, thus cutting off the affected section, and allowing the fire to gradually burn out.

GAS ANALYSIS—WARRIOR RUN MAIN RETURN.

AUGUST.	TIME.	CO_2	O_2	CO	CH_4	SHAW CH_4 + CO.	CALC. N.		TEMPERATURE.	
									Outside.	In Shaft.
4	5:00 P.M.	2.0	16.2	0.3	?	3.5	69.7	In Fan.		
5	3:00 P.M.	2.3	15.8	0.2	?	?	69.2	In Fan.		
7	5:00 A.M.	2.3	15.5	0.2	3.4	?	68.0	In Fan.		
7	5:00 P.M.	2.9	15.3	0.2	3.5	3.7	69.5	In Shaft.		
7	5:00 P.M.	2.4	16.0	0.2	3.9	0.4	70.3	In Fan.		
9	9:00 A.M.	3.0	15.6	0.2	3.2	3.2	71.1	In Shaft.		
9	11:00 A.M.	3.5	14.9	0.4	2.8	3.7	70.7	No. 3 Return.		
9	3:00 P.M.	5.5	11.6	0.2	3.5	?	65.4	No. 3 West.		
10	12:00 M.	Inside slope sealed below No. 3 and air turned in No. 3 tunnel.								
10	2:00 P.M.	3.4	15.4	0.2	2.1	3.0	71.8	In Shaft.	73°	81°
12	8:20 A.M.	2.8	16.1	0.3	2.3	3.2	73.4	In Shaft.	79°	81°
13	1:20 P.M.	Fan reduced from 79-50 r.p.m., water-gage 1.48 to 0.58 in.							83°	83°
13	4:50 P.M.	3.1	16.0	0.1	2.7	4.2	72.8	In Shaft.	82°	85°
14	4:50 P.M.	3.8	14.8	0.2	2.6	3.7	71.1	In Shaft.		
15	10:50 A.M.	Intake sealed, water-gage 0.82 at 54 r.p.m. of fan.								
15	11:10 A.M.	3.3	15.8	0.1	2.6	4.6	73.0			85°
15	11:14 A.M.	Fan stopped, upcast sealed.								
15	12:15 P.M.	5.3	10.7	trac.	11.6	?	60.4			
16	3:30 P.M.	6.4	6.3	0.3	12.5	?	48.8			87°
								WATER-GAGE.		
17	9:00 A.M.	6.2	5.1	0.1	14.2	?	43.1	0.4 in.		84°
17	12:00 M.	6.6	5.1	0.2	16.8	?	44.8	0.5 in.		78°
21	10:00 A.M.	5.4	1.9	0.0	24.0	?	27.7	0.7 in.		
24	8:00 A.M.	5.0	1.6	0.0	31.7	33.3	25.8	0.75 in.		
27	8:00 A.M.	3.9	1.4	0.0	33.4	37.4	30.1	1.0 in.		
SEPT.										
1	8:00 A.M.	4.1	2.8	0.0	41.0	42.8	26.2	0.75 in.		82°
10	9:00 A.M.	4.2	3.8	0.0	36.3		30.4	0.85 in.	72°	83°
22	8:00 A.M.	4.2	2.4		30.2		*25.1	0.5 in.	76°	83.5°

December 1, opened upcast and restored ventilation.

and the upper layer of fire-damp run off gradually. As the engineer of the company put it, he skimmed off the top of this, and then opened the air tunnel so that the natural circulation started up the fan shaft; this was done with great care as any spark at that time would have meant destruction. When the fan was started, the marsh-gas percentage was down below the explosion point.

This fire is, I believe, the only one that has ever been followed closely with analyses of the gases, so made as to show the results of cutting off all access of air.

It is always very difficult to know when a fire is out. In one case in the Luke Fidler colliery, Shamokin, which was flooded, the fire occurred in the last breast from the gangway in the lowest lift of a long inside slope, from the level of the bottom of the shaft. There were, I think, four lifts on the slope, and on the lowest the breasts were only up a short distance and not holed through to the slope men were left within shouting distance of each other, in case of accident.

We got to the head of this slope, and then lowered down a mine car, until the engineer said he could feel it strike water, measured the rope as it was hoisted back, and found the car wet for about half its length, showing from the map the elevation of the water, afterward verified by going down to it.

We left the fire in there entirely closed off, and under this water for some four months, and when the water was pumped out at the end of that time, the fire was there just the same; it started up again, and was sealed in with a clay and timber battery. It does very little good to flood and compress air against fire. It will smolder for months.

OTHER METHODS OF ATTACK

Another method of fighting fire was used by the Delaware, Lackawanna & Western Railroad Company; they had a

Pig Iron in Canada

The American Iron and Steel Association has received direct from the manufacturers the statistics of the production of all kinds of pig iron in Canada in the calendar year 1906. The total amounted to 541,957 long tons; of which 525,716 tons were made with coke, 16,021 tons with charcoal, and 220 tons with electricity.

The iron made is classed as below:

	1905.	1906.	Changes.
Foundry and forge...	146,698	130,120	D. 16,578
Bessemer pig.....	149,203	165,609	I. 16,406
Basic pig	172,102	246,228	I. 74,126
Total.....	468,003	541,957	I. 73,954

The total increase was 15.8 per cent. Canada has not made spiegeleisen or ferro-manganese since 1899.

On Dec. 31, 1906, Canada had 15 completed blast furnaces, of which 8 were in blast and 7 were idle. Of the total 12 usually use coke for fuel and 3 use charcoal. In addition one furnace, to use coke, was being built and 3 coke furnaces were partly erected on Dec. 31. Work on the partly erected furnaces was, however, suspended some time ago.

The French consul at Kharkoff reports that the production of manganese ore in that district in 1905 was 31,000,000 poods. The ore comes principally from two deposits in southern Russia, one in the district of Charopanski and the other in the Douetz region of the Nikapol district. The manganese ore coming from the Nikopol district is sold to Silesian smelters. The manganese ores of southern Russia also find a ready sale, nearly the whole of the production being secured by contract for native or foreign consumers for several years in advance.

COAL MINING IN EASTERN ILLINOIS

Details of Equipment and Methods Employed by The Dering Coal Company

BY F. W. PARSONS

The coal beds of Illinois form the most extensive bituminous field that is found in any State, and until the past year, when labor troubles in this district permitted West Virginia to surpass it in production, the Illinois output was only exceeded by that of Pennsylvania. Outside of Pennsylvania and Virginia, the Illinois deposits were our earliest coal discoveries, having been mentioned by French missionaries in the middle of the seventeenth century. The first authentic record of production shows that, in 1832, less than 5000 tons of coal were mined, and shipped by flat-boat down the Mississippi. Since 1896 the Illinois production has doubled, which indicates that if the present rate of development is carried on for ten more years, the coal output will reach 80,000,000 tons per year.

TIPPLE AND POWER PLANT AT MINE NO. 1, DERING COAL COMPANY

Of the many districts throughout the State, the Springfield region produces the largest tonnage, while the second greatest output comes from Belleville and Williamson counties. The Vermillion county district is the third largest producer, and is the seat of operation of the Dering Coal Company. Danville is the most important town in this region, and in large part, owes its rapid development to the many coal operations here surrounding.

Most of the mines in this locality can be reached by some line of the Interurban trolley system, while the tonnage from the mines is shipped over the Chicago & Eastern Illinois, and is used principally for steel making by the Illinois Steel Company, and other similar concerns.

GENERAL EQUIPMENT

One of the most modern operations in the Danville district is that known as the Dering No. 2 mine. The coal seam at this property lies practically horizontal, and is reached by a shaft 222 ft. deep. The boiler plant consists of five return tubular, 500x60-in. boilers. A pair of hoisting engines drive a conical drum, which latter varies in diameter from 5½ to 7 ft. For ventilating the workings, a Crawford & McCrimmon 20-ft. blower fan is used. The fan is run at 40 r.p.m., and at this rate forces 70,000 cu.ft. of air per min. If desired, the fan will make 120,000 cu.ft. at 80 r.p.m.

For handling the coal on the main haulways, four Westinghouse 5-ton motors are used. These locomotives are equipped with a self-coiling reel, so that when desired, they can be used as gathering motors. On the main entry, nothing less than 30-lb. rails is used. In the more remote workings and for gathering from rooms, 26 mules are employed. The underground stable, where these animals are kept, is sanitarily arranged, and is ventilated by sending a split from the main intake current through the stable and immediately into the return, thus preventing the contaminated air from the stable to pass on into the mine and affect the workmen.

TIPPLE AT MINE NO. 2, DERING COAL COMPANY

METHOD OF MINING

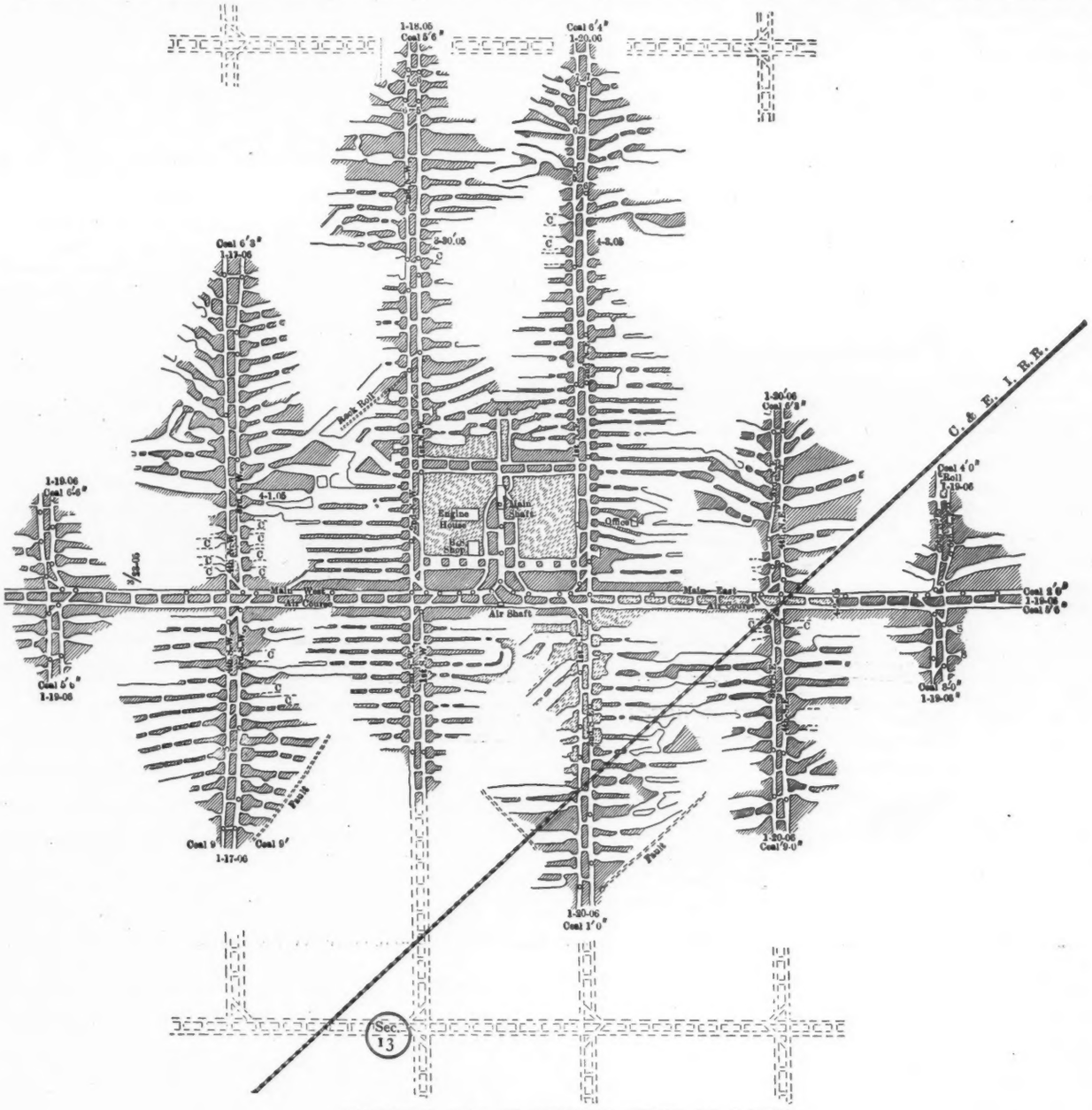
The general plan of development may be seen by examining the accompanying mine map. As is the custom in most Illinois and Indiana mines, the coal is shot from the solid, and an effort is made to secure as large a tonnage as possible on the advance work, and attempt to get practically nothing by robbing on the retreat. It has always been claimed by operators in most parts of Illinois that a successful method of robbing cannot be here carried on, because of the nature of the roof and overlying strata. For this reason it is the practice to drive all rooms as wide as possible, leaving only large enough pillars to support the roof and prevent a squeeze. As a general rule, the entries are driven 9 ft. wide and rooms 26 ft. in width. Room centers are 32 ft. apart, which leaves only a six-foot pillar between.

The room necks are 18 ft. long and 9 ft. wide. The main entry is separated from the first room by a 40-ft. barrier pillar, while only a 20-ft. pillar separates the main entry and its air course.

One of the heaviest items of expense in mining this Illinois coal is from the necessity of having to timber heavily to support the roof. Occasional faults and rolls are encountered, but such irregularities in the seam are generally local and have not afforded much trouble. It was formerly the practice to mine part of the coal by machines, but this method has been abandoned, as it was found impossible to get clean coal where machines were employed, and the consumers who wanted the coal for steel manufacture demanded that no dirty coal be shipped.

A unique arrangement is shown in the accompanying drawing for disposing of the empty cars that return from the surface after being dumped. For hoisting the product, two self-dumping cages are used; as each cage reaches the bottom, a full car is dropped down the loaded track, which is on a slight incline; this loaded car bumps the empty tub, causing it to run off the cage and down a light grade to a swag; here it is caught by the

dogs on an endless chain and hoisted up a short 30-deg. incline. At this point the car is again released and runs by gravity through a spring-latch switch, striking a buffer block, which causes it to run back and follow the empty track, down a slight grade, to a parting where the empties are collected and hauled by a motor to the working places. This arrangement is most efficient, and although not uncommon in a tipple or other surface plant, is seldom found in an underground installation. The entire arrangement, including the sprockets, chain and engine is plainly shown in the drawing. The place where such an installation as the one just described would be most efficient is in a mine where the shaft has been located close to the boundary of the property, and as a consequence, the space available for switching and collecting empties is limited. Such a plan also concentrates the haulage system and reduces the number of men necessary.



HORIZONTAL PLAN OF WORKINGS, DERING NO. 2 MINE

HOISTING AND SCREENING

The Dering No. 2 mine has a daily output of 2000 tons, and a maximum capacity of 2500 tons per day. The cages are of the self-dumping style, and are so arranged that when the top of the hoist is reached and the cage is momentarily resting on an incline, a man standing at the top operates a hanger rod which releases the end of the car and allows it to swing open, permitting the coal to slide into the weigh basket. This latter is of the general style found in the region, but possesses one unique feature, in that it can open at either end and thus load run-of-mine on the front, or screened coal on the rear; this change can be effected without removing or substituting any of the plates.

The screens that are used are of the shaker type, and designed to produce all of the different sizes. One difficulty resulting from the use of such screens is the harmful vibration that the tipple building must endure. This constant shaking strains the timbers and makes the entire structure unstable. For this reason, it is now thought advisable to have the timbers supporting a shaker screen separate and independent from the floor and sides of the building.

CHARACTER OF THE COAL

The Illinois coal field contains seven distinct seams; of this series, however, two veins are not now considered commercially valuable. The seam known as No. 6 ranges in thickness from 6 to 8 ft., and

is the largest source of production. Although this bed is principally confined to the central portion of the State, an important district exists in Vermillion county, south of Danville.

In this locality, as before stated, the seam lies more than 200 ft. below the surface. The coal bed known as the Danville seam is 110 ft. above the No. 6 coal, which latter bed in this district is called the Grape Creek vein. The Danville seam is 40 in. thick, and is covered by 40 ft. of soapstone, while above that is 60 ft. of clay. On an average, the Grape Creek vein here worked is 7 ft. thick, and will run about 7 per cent. ash; 8 per cent. moisture; 34 per cent. volatile matter; and 51 per cent. fixed carbon. Although many coals with a composition similar to this will produce a good quality of coke, it is true, however, that the coals in Illinois have not yet been successfully coked.

This is but another verification of the general statement that the coking properties of a coal cannot be accurately determined from its chemical composition.

The most serious problem in Illinois coal mining is to select a method of operation that will secure a larger percentage of the coal seam, and still deal effectively with the bad roof which prevails. The panel system of working which is successfully carried on throughout West Virginia and Pennsylvania, has so far met with little success in Illinois; however, now that many of the independent companies have passed into strong consolidations, it is probable that one of the larger concerns will experiment and endeavor to develop a suitable method where the pillars will be robbed and a larger percentage of coal safely secured.

The Gordon Drill

An extended series of tests of the Gordon drill, manufactured by the Ingersoll-Sergeant Company, has been conducted at the Robinson mine, Witwatersrand, S. A., according to the London *Mining Journal* of Jan. 12, 1907.

Briefly, it is an air hammer mounted on the usual rock-drill column or bar and has the appearance of a piece of 3-in. pipe; attached to it is the usual crank handle for the screw feed; in this case, however, the handle serves to rotate the drill only. The piston strikes the drill instead of being part of the striker, the consequence being that it has only to be rotated, being kept up to its work by air pressure, and not being drawn in and out as in the ordinary drill.

The drill steel is hollow, so as to enable a water jet to be used, and the bits used are the ordinary star, a special machine having been introduced to sharpen them. The whole outfit weighs 115 lb. (the drill 55 lb. and the column and the bar 60 lb.). There are no nuts or screws, wedges being used to attach the drill to the arm.

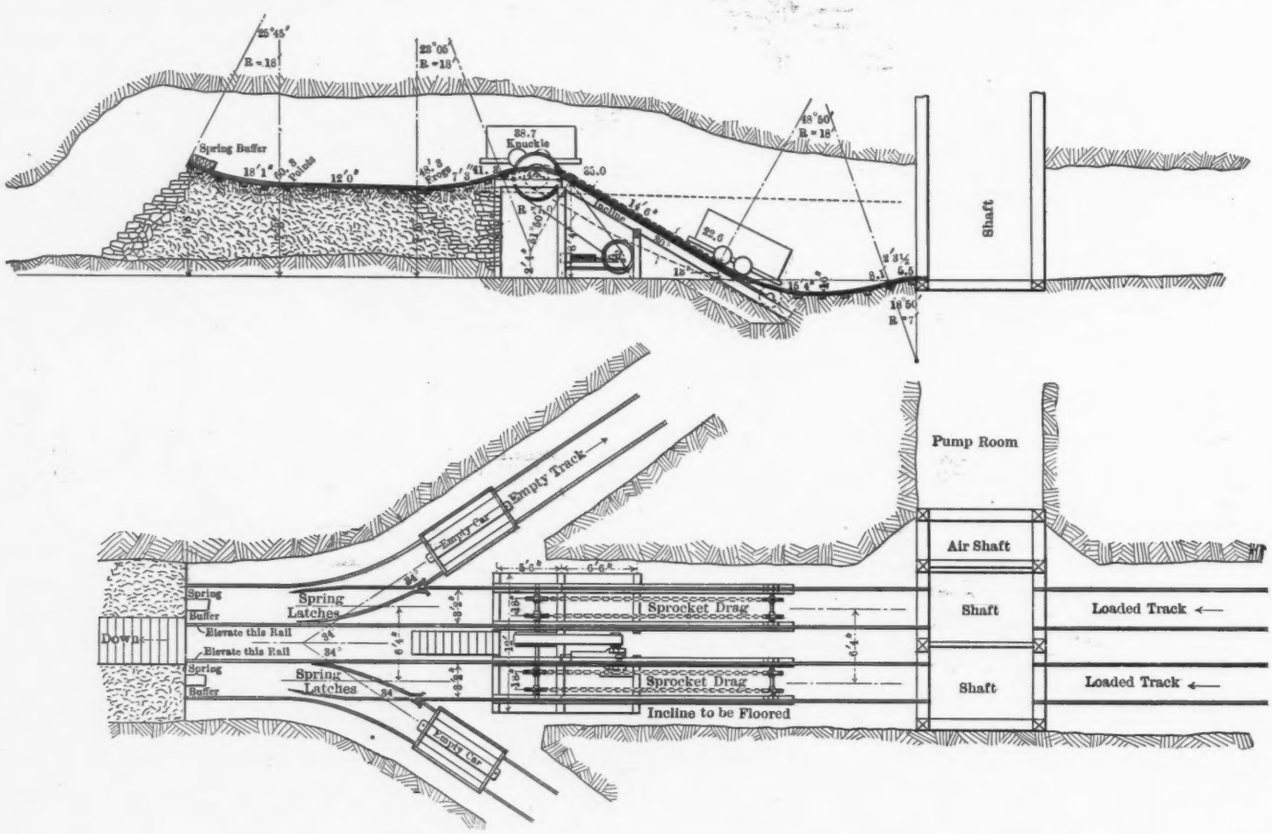
It is claimed the drill is fool proof and can be easily worked by Kafirs; the results at the Robinson mine show that three drills, employing four Kafirs, are doing the work of 25 Kafirs, and doing it better. The experiment has been carried out on a reef under 24 in. wide, the stopes being kept at 30 in. instead of 48 in. with larger machines in the same stope; this means that the grade of the ore is considerably increased, as only 6 in. of waste is mined and hauled, as against 24 in. with the ordinary drill.

These machines require only 25 per cent. of the air required to run a 3¼-in. drill, and the following table shows that the average footage per shift is 14.12 ft.

The accompanying is a record of the work done by the Gordon drill at the Robinson mine between Oct. 27 and Nov. 26, 1906:

Machines used	11
Machine shifts	281
Holes drilled	1,249
Footage drilled	3,968
Average per hole	3.18
Average holes per machine shift	4.44
Average feet drilled per machine shift	14.12
Total fathoms	78.5
Fathoms per shift	.27
Fathoms per hole	.062
Average holes per fathom	16.00
Number of native shifts	374
Holes per native shift	3.34
Fathoms per native shift	.22
Number of working days	78
Cost per fathom	69s. 8d.

Copper is mined at Chouichia in Tunis, where the ore is smelted to a matte, assaying 35 to 50 per cent. copper, which is exported.



ELEVATOR AND SWITCH-BACK FOR EMPTY CARS AT DERING COAL COMPANY NO. 2 MINE

COLLIERY NOTES

Details in the Operation and Development of Anthracite and Bituminous Mines

In prospecting it should be remembered that all sandstones of Carboniferous measures are gray, while those sandstones above and below the coal measures are usually red.

When a coal seam is faulted and folded, it is sometimes possible to distinguish the roof of the seam from the bottom by the presence of fern leaves, which, if they are present at all, will generally be found in the top of the seam.

It is generally unknown that on the continent of Europe coal has not only been found but has also been mined in Silurian formations. A variety of seaweed, the only plant known in this age, is thought to have formed the coal.

The various coal fields of the United States, located east of the Mississippi river, have a combined area of about 110,000 square miles. The coal area west of the Mississippi is more than twice as large as that of the eastern territory.

Generally speaking, pillars with their longest sides parallel to the pitch of the seam are the strongest. If in this connection, the "face" and "butt" cleats in the coal also run to the dip or to the strike, the conditions are more nearly ideal, and the pillars will not only sustain the maximum weight, but the seam can be mined more easily and in better blocks with less fine coal.

To find the tonnage per acre, multiply 62.355 (the weight of 1 cu.ft. of water) by the specific gravity of the coal, which gives its weight per cubic foot. This result, multiplied by 43,560 (the number of square feet in one acre), and again multiplied by the thickness of the seam in feet, gives the number of pounds of coal in one acre. If this last result is divided by 2240, the quotient expresses the number of long tons per acre.

At the mines of the Delaware, Lackawanna & Western Coal Company, in Pennsylvania, one of the precautions taken to prevent serious mine fires is to establish a system of pipe lines along the main entries in gaseous workings. The total length of piping in six collieries is approximately 15 miles; the cost of material and installation was about $14,500, and the average yearly cost of maintenance at each colliery is about $1000.

At many mines too little care is exercised in selecting a site for the culm and waste piles, and an insufficient amount of calculation and study relative to the size of the pillars necessary to sustain this added weight is devoted to this subject. It is not unusual to find a superintendent carefully providing for the protection of a shaft, power-house or other surface building and neglecting a pile of culm or waste many times the weight of any mine building.

In shipping coal from the anthracite fields to New York and other points of storage and consumption it has been found that, after being loaded in the cars, there is practically no breakage whatever due to transit or other similar causes. Neither is there any accumulation of dirt or fine coal in the bottom of the gondolas, unless it was dumped there in loading. This statement applies entirely to anthracite coal and not to any soft and friable bituminous product.

Considerable caution must be exercised in drawing any conclusion as to the thickness and dip of a coal seam when only slight prospecting has been done at the crop. When the seam outcrops on a hillside there is often a confusion of strata, caused by a landslide or other dislocation of the surface. In such cases the apparent dip may not only be misleading, but the seam may be so squeezed and folded that a correct idea of its true thickness can only be obtained by driving a tunnel in far enough to get away from surface disturbances.

Under no circumstances, in a gaseous face, should any miner be allowed to shoot down more coal each day than can be cleaned up and loaded out by him before leaving at night. If serious mine fires are to be eliminated, this rule must be carefully observed, for in case of a feeder left burning, or other cause that might start a fire in the face, the flames would not burn so fast nor get under headway so quickly if there were no loose coal near by. Coal in the solid requires much time before forming an extensive fire hard to control.

In sinking an exploratory shaft to test a coal seam it has been found that a square shaft is best adapted for loose, treacherous ground, and has the further advantage of being easy to timber. When the pit is not more than 20 ft. deep the earth can be shoveled to a staging, from which it is thrown from the pit. If the shaft is more than 20 ft. deep, a windlass becomes necessary. It is advisable to have the timber girths not more than 4 or 5 ft. apart. If the shaft is less than 50 ft. deep, a 5x5-ft. hole is large enough to give proper working room.

A study of the vegetation and conditions that prevailed during the Carboniferous age, when our coal beds were being formed, indicates that the climate of that period was uniformly warm, with much moisture and an absence of strong winds or currents of air. There was also a large quantity of carbonic acid present in the atmosphere, which was drawn upon and aided materially in furnishing material for our coal deposits. This highly carbonated condition of the atmosphere, while increasing the luxuriance of the vegetation, was unfavorable to animal life.

In a serious mine fire, where the burning portion must be isolated from the air by special stoppings, expert opinion now favors the method of closing the return-air side first and sealing the intake opening last. The reason for this is that the gases liberated by the fire are dammed in and drive back the fresh air, the preponderance of gas and lack of sufficient fresh air acting to prevent an explosion. After all the stoppings have been built and the fire is thought extinguished, the work of opening the workings must proceed with caution and in reverse order to the method adopted in sealing; that is, the stopping at the intake end is first opened, and the return-air side is opened last.

Experiments show that there is a limit beyond which there is no advantage in attempting to re-screen and further prepare anthracite and bituminous coal. In one instance, where a ton of hand-picked coal was used, the process of screening furnished 3 per cent. undersize which went through the screen, while a still larger percentage of undersize formed by the handling went over the screen and was held by the coal. In repeating the operation, another 3 per cent. of undersize was caught, while the coal again held a proportion of undersize, similar to that previously found. It was believed that the process might be repeated indefinitely without materially benefiting the grade or separation of the coal.

In determining the load that can be safely held by a rectangular wooden beam, supported at both ends and loaded in the middle, a simple method is to multiply the square of the depth of the beam in inches, by the breadth in inches, and then divide this product by the distance in feet between the supports; this quotient is multiplied by the constant given as the breaking load (600 for oak, and 500 for pine). The result of this operation should always be divided by three to get the safe working load; and furthermore, if the timber is green, this last result must again be divided by two. In calculating for a cylindrical beam, the above operation is followed, except that instead of using the breadth and depth, the cube of the diameter is taken.

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The Zinc Ore Question

In the matter of the protests of various smelters against an order fixing a duty on zinc ore a decision was made, Feb. 5, by the Board of General Appraisers. By an order of the Secretary of the Treasury, Feb. 10, 1906, it was held that the term "calamine" in the Dingley Tariff referred only to the hydrous silicate of zinc, and that sulphide and carbonate ores were dutiable at the rate of 20 per cent. *ad valorem.* The Board of General Appraisers has completely reversed the Treasury interpretation of the law, its conclusion being that the carbonates and silicates of zinc are included within the meaning of the term calamine, as used in the Dingley Act, and consequently are free of duty, while the sulphide of zinc is also free under paragraph 614 as a crude mineral not advanced in value by any process of manufacture, subject to the qualification that any lead contents of these ores are dutiable at the rate of 1.5c. per lb., as prescribed in paragraph 181.

The decision as to calamine was a foregone conclusion, inasmuch as anything different would have violated the accepted commercial and metallurgical practice of a century, as was done ignorantly in the Treasury order of Feb. 10, 1906. The fact that mineralogists had a more recent and more restricted meaning for this term, or rather some mineralogists, because among mineralogists there were confusion and difference over the matter, could not rationally be allowed to supersede the preemption of the term by metallurgists, who had never abandoned it from their common usage or lost their understanding of it. The surprising thing is that the Government should have considered it had any ground for contest on this point.

Commercially this is the more important part of the recent decision, inasmuch as the bulk of the importations heretofore have been of calamine, but the more remarkable part is that which relates to blende. It is to be admitted that when the Dingley Law was enacted no one thought that in a few years the United States would be importing zinc blende, and when such importations were begun there was ground for the belief that blende fell under the "catch-all" paragraph, providing that "metallic mineral substances" in a crude state, not elsewhere specified, should be dutiable at 20 per cent. *ad valorem,* as the Secretary of the Treasury ordered. Now the Board of General Appraisers, guided by a decision of the circuit court of appeals in what is considered to be a parallel case, holds that the phrase "metallic mineral substances" applies only to that class of mineral substances in which metal appears in a free state, such as the ores of gold, silver and copper. Inasmuch as the only ores of the above character which are of commercial importance are those of gold, silver and copper, and they are specifically on the free list, this clause in the Dingley Act under the recent decision becomes meaningless. Literally this interpretation of the adjective "metallic" is doubtless correct, but if that adjective be limited in this way we shall need something to take its place in every-day usage. The chemical compounds which occur ready formed in nature are called minerals; and the minerals from which the metals are extracted for practical purposes are called ores. Ore is commonly defined as a metallic mineral substance. Now we are told that this is incorrect. But if not metallic, what? Certainly not metalliferous—metal bearing—which is far broader than metallic, including every mineral which contains a metallic element, whether commercially extractable or not.

However, the whole of the recent decision is certainly in line with the spirit of the existing tariff law. In the tariff of 1792 calamine, under the name of *lapis calaminaris,* was specifically put on the free list, and it has so remained in every tariff act except those of 1846 and 1857. In 1792 all of the oxidized ores of zinc were known as calamine, the difference between the anhydrous carbonate and the hydrous silicate being unknown until their true composition was determined by Smithson, in 1803. For many hundred years, however, these ores had been employed as a source of zinc for the manufacture of brass by the cementation process, long before it was known how to reduce them to spelter. When Congress put calamine on the free list, in 1792, it was undoubtedly for the purpose of encouraging this industry in the United States; we have read that brass was actually made by the cementation process in the United States in the early part of the nineteenth century. Obviously the continuance of calamine on the free list was intentional, and it is equally obvious that the Congress which passed the Dingley Act did not have any intention of making the more easily smelted ore of zinc

free, and the more difficultly smelted ore dutiable. The recent decision may be regarded therefore as an escape of the innocent blende from the jaws of the "catch-all" clause rather than as a quibbling defeat of the purpose of the framers of the law.

We think it unlikely that there will be any appeal from this decision, inasmuch as the zinc-ore producers who have been urging the exclusion of the foreign ore appear to have lost interest in the matter. The importations have continued under bond since the Treasury order at a greatly increased rate over 1905; yet the price for zinc ore has continued at a high enough level to satisfy everyone. The fact is that many of the foreign producers require high prices just as much as the domestic. An important effect of the decision will be the reopening of the American market to the producers of British Columbia, their product being entirely blende. This will be no cause for regret. The sound commercial policy is to let our smelters have all the supply of free raw material they need. The Canadian and Mexican ores will find a market anyway. American smelters, rather than European, should have the smelting of it, and if there be any surplus let it be spelter to be exported, not ore.

The Mining Fraud Question

The suppression of mining frauds is one of the live questions of the day. It is not a simple question. If we should provide the means really to suppress them we should come to State or national control of the mining industry. Even then we should not be safe, as witness many scandals in the post-office department, the public lands, and the administration of public works. And why should there be all this clamor about mining frauds, as if there were no gold-out-of-sea water frauds, Keeley motor frauds, ship-building frauds, and the watering of the stocks of industrial companies of all kinds? It belittles the great mining industry to single it out as one which especially is guilty. Yet it is a fact that because of the attractiveness of the mining industry, the possibility of hitting upon great bonanzas which may centuple the investment, and the general ignorance of the public as to its conditions, it has been selected by sharpers as a fruitful, perhaps the most fruitful, field. It is to be admitted frankly that the sore exists.

All that the Federal Government or the States can do in such matters, whether they pertain to the fraudulent efforts of corporations or individuals, is to exercise their police functions. They can run down and punish a crime committed; they cannot prevent the commission of the crime except by making it so dangerous to be criminal that no one will risk being otherwise than good. At present there are plenty of laws for the punishment of crime. In this case the difficulty is in proving the crime. The States do not know how to exercise their proper police functions.

The fraudulent promoters may be divided into several classes:

1. The deliberately dishonest. His trade is the selling of lithographed paper. He ranks with the sharper who advertised a sewing machine for a dollar and sent his victims a needle. When subscriptions for his "stock" come in freely he speaks of business as being good. He does not concern himself about any mine development: usually he is wise enough to provide himself with a patent, a mine, or some alleged asset. Patents can often be secured for $5 or $10 apiece, and a mine may be a claim anywhere.

2. The semi-dishonest. Those who acquire real property which they capitalize and sell to the public at an exorbitant valuation, unjustified by any actual conditions and unbelieved in by themselves.

3. The honest, but ignorant. Those who deceive themselves and with no wrong intentions deceive other people who listen to them.

4. The visionary. Exemplified by Col. Sellers.

There is only one of these classes which is easily subject to the attention of the police, district attorneys, or the post-office inspectors. This is class 1. They are frequently run down and punished, as for example Letson Balliet, Alfred Goslin and Dr. Flower. The schemings of the gentry of their class make good newspaper stories, add considerably to the general hilarity, but after all do not cause the loss of very much money in the aggregate, although in individual cases they produce the same anguish as the hayseed feels after he has bought a gold brick.

It is classes 2, 3 and 4 which are the dangerous ones, but it is seldom that they can be tripped, although we may feel positive that the public to whom they appeal for money is being misled. It is only occasionally that one of them makes the palpably false statements that the promoters of the Clover Creek Quicksilver Company did a year or two ago and thus becomes subject to a post-office fraud order.

One of our correspondents proposes a State inspection of mines, but how could such be carried out in any safe way? When our great mining syndicates, employing the best engineers, make the mistakes which they do; when the property of the Greene Consolidated was originally condemned by good engineers, and the company was brought out by full-page newspaper advertisements, just like many at present; what would the opinion and dictum of a district engineer lead us to? Simply to this: Promoters would advertise that their property had been passed by the State, just as the Black Sand & Gold Recovery Company now brings the names of the U. S. Geological Survey and the Federal Government into its literature. This would be an evil worse than any we have now. The present mineral-land law requires discovery of mineral to be made as preliminary to location, and the inability of the Government to enforce that apparently simple provision is proof enough of the inability of the State to regulate mine valuations by inspections.

The only remedy for mining and other frauds is an improved morality on all sides; greater reluctance among promoters to father undertakings that they have not properly investigated; carefulness among the newspapers about accepting advertisements which look suspicious (the newspaper not being bound to print anything it does not see fit to); education of the public to exercise of the same caution which it displays in investments in familiar lines; publicity in corporate affairs. In the last connection we believe that a Federal corporation law, supplemented by State laws, modeled after the British, would be decidedly advantageous. But even the latter does not prevent Whitaker Wright scandals and it must be recognized that even the best and most stringent laws cannot keep everyone honest.

ADMIRAL ROBLEY D. EVANS, in the *North American Review*, proposes that our Government acquire and hold the entire anthracite coal field of Pennsylvania to furnish a smokeless fuel for use in the U. S. Navy. An invisible navy would be a great advantage in an emergency, but there are other considerations which to the landsman seem to be of some importance.

The Stuart Colliery Disaster

BY F. W. PARSONS

The attention of coal-mining men, if not the entire country, is again directed to West Virginia, where the alarming loss of life caused by mine explosions continues to occur.

On Jan. 29, one of the worst explosions the State has ever witnessed took place at the Stuart mine. This property is located in the heart of the New River field, which district seems destined to suffer repeatedly from such disasters. The coal dust in this region is probably more readily inflammable than that of any other field, and as a consequence the explosions that occur are never local, but rapidly spread to all parts of the mine, increasing in force as they travel, and leaving but little hope that any men present in the workings will survive. One characteristic of these explosions is that the greater force is nearly always spent on the intake airway, proving conclusively the preponderant influence of dust.

The Sewall seam which is here worked is somewhat gaseous, but when compared with many seams in the anthracite field, the gas content becomes most insignificant. The point, however, that seems to be here emphasized, is the fact that a serious explosion only requires enough gas to cause the initial concussion and project flame into the dust that is raised.

LOCATION

The Stuart mine is one of the newer operations, being located on the higher plateau back from New river, and shipping its product over the Chesapeake & Ohio Railroad, connecting with the Loop Creek branch, near Glen Jean. The company owns the miners' houses and operates a department store which furnishes all the necessities to the workmen and their families.

CHARACTER OF THE COAL

The seam here mined is known as the Sewall vein, and is undoubtedly the best coal for steam, domestic and general fuel purposes in the world, not excepting the best grades of Cardiff coal from southern Wales. The dip of the coal bed in this region is generally in a northwest direction, while the strike of the seam bears about north 40 deg. east. In few places does the seam have an inclination of more than 3 per cent., so that the problems of mining are not difficult. Few faults occur, and practically no partings in the coal bed are found. Roughly speaking, the Sewall coal occurs 340 ft. above the Fire Creek seam, and varies in thickness from 2 to 6 ft. In passing eastward from Stuart, where the coal is 4 to 5 ft. thick, the seam decreases in thickness until at Hawk's Nest, the bed is but 2 ft. 6 in. thick.

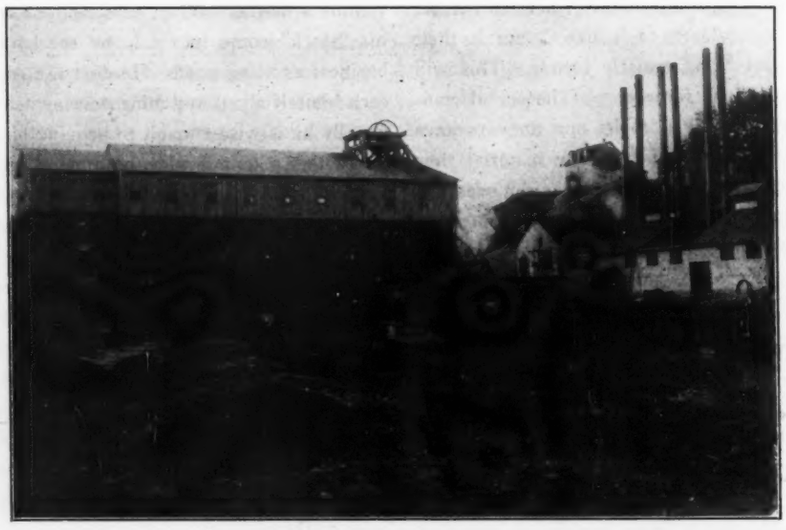
The average composition of the Sewall coal at the Stuart mine is about as follows: Moisture, 1.70; volatile matter, 21.66; fixed carbon, 72.01; ash, 5.75; sulphur, 0.71; phosphorus, 0.005. The coal has a heating value of 15,200 B.t.u.

METHOD OF OPERATION

The Stuart mine operates a shaft 568 ft. in depth. The method of development is on the double-entry system, with cross entries at right angles to the main entry and rooms driven from these cross entries. The coal, being of such exceptional purity, is neither washed nor picked, and furthermore, has been generally shipped as run-of-mine. In the accompanying illustration is shown the tipple, head frame, boiler-house, power-house and fan-house.

CONCLUSION

Such occurrences as that which the Stuart mine has just experienced are most deplorable, and stringent measures must be taken by the State authorities, if these accidents are to be eliminated. The class of labor in West Virginia is as intelligent as is found in other States, and the men in charge of the mining operations are equal in ability to those who direct operations in other districts. In drawing a conclusion therefore it is only fair to say that the mines of the New River district are particularly dangerous because of the greater inflammability of the dust, and this means that stricter rules and increased precautions must be observed. Much dust should be removed, pipe lines installed along the main and cross entries, with the size of pipe varying from 3½ in. in diameter near the pit mouth, to ¾ in. at the working face. At intervals of 150 ft., taps could be provided, so that short lengths of light hose might be readily attached by the man who does the watering. The spraying can be done by compressing the end of the hose with the finger or thumb, so as to obtain a scattered jet. This should be repeated as often as necessary to prevent the dust from drying. As a further remedy, the operators should send a greater current of air into the mines, and see that this air is not short circuited and lost through faultily constructed brattices. It is a fact that 100,000 cu.ft. of air per min. in the main intake does not often mean one-twentieth this amount at dangerous faces. West Virginia operators have not exerted themselves as they will have to do if further disastrous accidents are to be prevented.



THE STUART MINE IN WEST VIRGINIA, SCENE OF THE RECENT DISASTER

The Cornwall Iron Ore Mines

The Cornwall mines, in Lebanon county, Pennsylvania, were one of the first deposits of iron ore opened in this country, mining having been begun there in 1740. They passed through various ownerships; for 42 years, since 1864, the mines have been owned and worked by the Cornwall Ore Bank Company. The output of these mines has been as follows, in long tons:

From 1740 to 1790	300,000
From 1790 to 1848	700,000
From 1848 to 1864	1,524,907
From 1864 to 1906	19,662,992
Total, to end of 1906	22,187,899

These mines are not exhausted; a proof of which is that the production in 1906 was 763,788 tons, the largest yearly output ever made, with one exception—769,020 tons in 1889. The record of 166 years' working cannot be equaled by any other mine in the United States.

Consul General Guenther, of Frankfort, describes a new alloy of aluminum and zinc known as "alzen." This alloy consists of two parts of aluminum to one of zinc, and is said to equal cast iron in strength and to be much more elastic. The new alloy is capable of filling out the most delicate lines and figures of forms in castings and takes a high polish.

A Virginia Gold Mine

BY EDWARD K. JUDD

In the midst of the general stagnation which has overcome the Virginia half of the Virgilina copper belt, which was described in the JOURNAL of Dec. 1, 1906, one mine is actively producing gold in a field where other mines are in search of copper. It is the Goldbank mine and is owned by residents of Virgilina, the company being incorporated under the name of Virgilina Mining Company, of New York. The operators of this mine are proceeding with the sane idea of paying expenses as they go, and to this fact probably more than to any other is due their present ability to run and make a profit, while nearly every other mine in the district is dormant or overwhelmed with capitalization.

The mine is situated about six miles directly north of the town of Virgilina. Its vein is parallel to and exactly similar to the other numerous veins of the copper belt, except that, besides a little copper, its chief value is in gold. The vein material is quartz, and the country rock is a highly altered andesite, in appearance almost resembling sedimentary slate. The vein strikes north and south and is nearly vertical. The gold, in an exceedingly fine state of division, is contained both in the quartz filling and in the contiguous altered country rock. Across the 6 ft. of its width the value of the vein is said to average $8 per ton. Copper sulphides are present in subordinate amounts, and no effort is now made to save them.

A vertical shaft has been sunk 160 ft. deep and on this level drifts have been run along the vein for a distance of 100 ft. to the north and 300 ft. to the south, taking out the whole width of the vein. The drifts are advanced by hand-drilling and maintain a hight of about 10 ft. A low heading is first advanced along the roof of the drift and the subsequent bench is then taken down behind. The broken-down ore is shoveled into wheelbarrows and wheeled on planks to the foot of the shaft, dumped on the ground and then shoveled into the wooden hoisting bucket. A steam hoist raises the bucket to a point above the surface, when the trap doors of the shaft are closed, a chain is hooked into the ring at the bottom of the bucket, the engine brake released, and the bucket dumped on the ground. The ore is then shoveled into a wheelbarrow and wheeled to the mill, about 100 ft. distant, where it is again dumped on the floor and shoveled into the crushers. Before condemning this apparently uneconomical employment of labor, it must be remembered that the wages of negro workmen in this district is not more than 75c. per day, and that with the comparatively small scale of operations, more extensive equipment for the handling of material is not warranted. If the mine prospers, such facilities will doubtless be introduced.

The mill is driven by steam and has two batteries of five stamps each, besides a crusher and two automatic feeders. Two more batteries are contemplated. The mortars are made by the Mecklenburg Iron Works, of Charlotte, N. C. The stamps weigh 750 lb. apiece, the shoes and the dies weighing 80 lb. apiece. Both chrome-steel and cast-iron shoes are used, the former lasting 18 weeks and the latter only six weeks. The stamp stems are of steel. The stamps have a drop of 6 in. and are crushing one ton per 24 hours apiece, through 60-mesh screen. Inside amalgamation plates are not used. The outside plates are 10 ft. long and are broken at intervals of 3 ft. to assist in catching the gold. Between 3 and 4 lb. of mercury are fed into the mortars per week.

No attempt is made to save or to treat the tailings, which are known to be rich in gold. The plates are scraped once a week and a general clean-up occurs once a month. Before going to the stamps the rock is put through a Farrel crusher and is then shoveled into Hendy feeders. Except for the battery attendant and the hoisting engineer, all the laborers are negroes.

The Cassel Process at the Stratton's Independence Mine

At the eighth ordinary, general meeting of Stratton's Independence, Ltd., held in London recently and reported in the *Mining Journal,* the chairman, the Right Hon. the Earl of Chesterfield, P. C., submitted a report of the action of the directors in regard to the treatment of the company's dumps and low-grade ores.

The possibility of treating the waste dump and low-grade ore at a profit was first brought to the directors' notice by H. R. Cassel, in 1903. The directors put themselves into communication with John Hays Hammond, who was then the company's consulting engineer, with the result that after some correspondence Mr. Cassell went out to the mine to make some small experiments in the presence of Professor Huntoon, selected by Mr. Hammond, to watch the tests of the process. Unfortunately, according to a report made by the manager, Mr. Becker, it appears that the plant at the disposal of Mr. Cassel and Professor Huntoon at the time was very crude and poorly arranged, so that the best results could not be expected.

As a matter of fact, Professor Huntoon's conclusions were of an indefinite character, but his report showed the process to have some merit, and though there was a low extraction, the cost of treatment was estimated by Professor Huntoon as 90c. per ton on a 500-ton plant. The mine manager at the time suggested that a small 10-ton experimental plant should be erected and experiments conducted systematically. This was confirmed by Mr. Hammond, who thought that the vital importance of a process for a cheaper and more efficient treatment of the dump and low-grade ore was so great that a further expenditure, not to exceed £2000, should be authorized to carry out experiments on the lines suggested by Mr. Cassel. Mr. Hammond's assistant, Mr. Beatty, also strongly recommended this policy.

Godfrey Doveton, of Denver, conducted the experiments in 10-ton lots of $3 ore, eleven of them in all, and in June, 1905, he made a very full report on the work. At the end of the report Mr. Doveton summed up the process under four heads. Dealing with the first head, crushing of dump ores, he found that from results of tests crushing to 20-mesh classification of sand from slime, concentration of sands, slime, and sulphurets by cyanidation would yield a maximum extraction. Under the second head, treatment of sands, he found that 78 per cent. of sand would be produced, yielding on treatment 40 per cent. of the value. In the third operation, treatment of slime, 20 per cent. of slime would be produced, having a value of $5 per ton. This would yield on treatment $3.5 per ton of slime. Finally, under the fourth head, treatment of sulphurets, 2 per cent. of sulphurets would be produced, having a value of $5 per ton, leaving a net return of $41.325, if treated on the ground per ton of sulphurets. On the experimental samples of 110 tons, in all of an average of $3 the extraction per ton of original ore was a little over $2, the cost of treatment a little under $1, and the estimated net profit a little over $1 per ton.

With regard to the Cassel filter, G. Doveton stated that, although working under rather adverse conditions, it did excellent work; that it is peculiarly adapted to the treatment of the slimes of the dump of the Stratton's Independence mine. He also gave the opinion that a vacuum system like that of the Cassel process is cheaper in installation, vastly cheaper in operation and more effective than filter pressing. The directors came to the conclusion that the value of the Cassel process and filter had been undeniably demonstrated.

After a series of negotiations concerning the erection of a mill and the making of further experiments with the Cassel process, Philip Argall was chosen to carry on the work, and was given free hand with regard to the treatment. It was stipulated that if the directors consider it necessary Mr. Cassel's assistant should be present during any further experimental trials that Mr. Argall may deem advisable.

The shipments of zinc and lead ore from Tunis in 1906 amounted to about 50,000 metric tons.

CORRESPONDENCE

Discussions by Our Readers of Various Topics of Interest

Theories Concerning the Flotation Process

The oldest theory concerning the flotation process was that a dilute solution of H_2SO_4 acting on the sulphides contained in an ore set free H_2S, which gas drew the metallic sulphides to the surface. The action of CO_2 was not taken into consideration.

Later when the method was used on other ores, especially those containing carbonates, conceptions concerning the working of the process changed. At the present time the belief that CO_2 has a direct action in the flotation seems to be fairly general, and the theory that other unknown physical and chemical phenomena are the causes is probably still more generally held.

If carbon dioxide were the active gas the carbonates ought to be the first particles drawn to the surface because they are the source of the gas. The specific weight of carbon dioxide is so great that the gas cannot carry particles to the surface unless it occurs in large quantities, or in large bubbles. There is no reason why CO_2 should occur more abundantly on sulphides than on other mineral particles. I have come to the conclusion that the old theory, that H_2S is the gas that causes flotation is the correct one, modified in some cases when applied to ores containing carbonates.

Carbon dioxide possesses so much greater solution pressure than H_2S that it drives the hydrogen sulphide out of solution, and also hinders H_2S from going into solution. Hence if a sulphide ore containing carbonates is treated with a dilute solution of H_2SO_4, and this solution is warmed, the first gas to be generated is CO_2; but the sulphides are also acted upon by H_2SO_4 and H_2S is set free. Now the CO_2 hinders H_2S from going into solution, and the latter becomes isolated and collecting on the sulphides forces the particles to the surface. As H_2S is a gas of low specific weight a very small amount of it collecting on the mineral particles is enough to draw them to the surface.

The practical conclusions based upon my theory are, therefore, that it is always advisable to have a carbonate present in order to use the flotation process for sulphide ores. But an amount of carbonates in excess of that needed to give the solution a sufficient amount of CO_2 must be looked upon as harmful. Too large an excess of carbonate causes too violent a generation of gas which carries away tailings and light particles during concentration. Too large an excess of carbonate may make the process entirely useless for practical purposes.

If there is no carbonate present in the ore the process is not as effective as it otherwise would be, for it is advisable always to have enough CO_2 present to keep the solution saturated. Flotation may, however, take place without the presence of CO_2, for at a higher temperature H_2S goes into solution with difficulty and the larger portion of the separated gas gathers on the particles and carries them to the surface.

The amount of H_2SO_4, and also the temperature of the solution must vary for different ores, and must be determined by experiment. That the practical arrangements as well as the methods of procedure also play an important part need hardly be mentioned.

G. HAGLUND.

Frederickstown, Mo., Jan. 28, 1907.

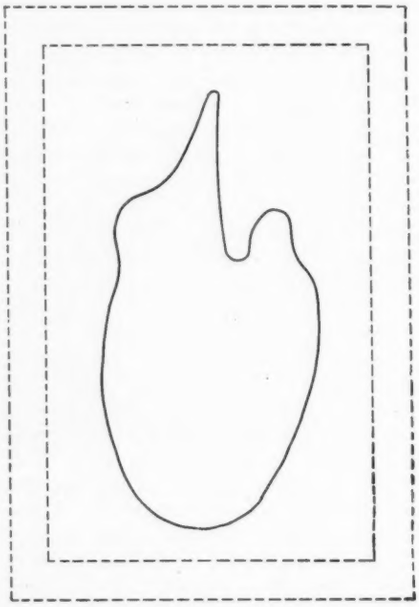
Patching a Steel Water Jacket

With proper treatment a steel or wrought-iron water jacket should never need patching, but furnaces do not always receive proper treatment and accidents are bound to happen. When the leak appears in a solitary little furnace in the wilderness far from railroads and bases of supply, one is not disposed to sneer at any plan which promises to stop the flow of water even temporarily. The patch which I mean to describe had every appearance of permanency. To my knowledge it did good service for three months, and there is no reason why that jacket should not be in commission today.

It was in the mountains of Mexico, at the end of a long and tortuous burro trail. We were trying to smelt the most villainous mixture of sulphides ever assembled in uncertain pockets. The ore contained quantities of zinc, arsenic and pyrites, very little lead and not enough copper to make a coherent matte. The men from foreman to slag sorter on the dump were all natives, mostly Indians as innocent of any knowledge of mechanics as the goats upon the surrounding hills. The plant was a small, round lead furnace with an adobe reverberatory roaster much too short for the job. When I add that we used a poor quality of charcoal because the least expensive coke cost $36 per ton at the charging floor, no other excuse for the damaged jacket will be necessary.

One morning the astonished tapper drew water instead of the usual sluggish stream of slag, and a chilled lead-well put an end to another abbreviated campaign. We removed the damaged section and prepared to fill the gap with brick, adobe, clay or whatever might answer the purpose. The jacket was thrown aside as "done for." There was a ragged, oval hole, about 3x5 in. directly above the tuyere opening.

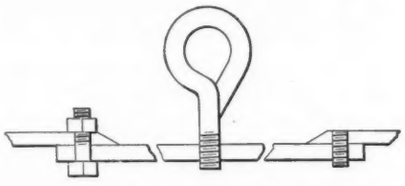
The man who looked after the machinery of the place was a big, good-natured Slav. He had come to the mine with a consignment of Krupp concentrating machinery, and had remained as a generally useful appendage. He spoke all the languages of the twelve Danube provinces, usually mixed with a few English words, and was a veritable Yankee for ingenuity. He dragged the damaged shell away to the shade of a pepper tree—it was February, but the thermometer registered between 100 and 105 deg. F. in the shade—and presently asked and promptly received permission to "compone" that jacket. He found a piece of ¼-in. plate in the scrap heap, and with the aid of a fragment of chalk made the native blacksmith and his helper understand what they were to do. Then he seated himself comfortably upon the handle of a slag pot, rolled a cigarette and superintended operations.



LEAK IN JACKET AND OUTLINE OF TRIMMED HOLE AND PATCH

The various steps of the process are shown in the accompanying sketches. The metal about the hole was cut away so as to form a rectangular opening about 4 in. wide and 8 in. long. The edges were given an easy bevel by means of a file. The piece of plate from the scrap pile was trimmed to form a corresponding rectangle about 2 in. wider and longer than the hole. To apply this patch to the outside of the jacket face was out of the question, for any projection would interfere with the descent of the charge. The space between the walls of the shell was too narrow for the use of tools from within; besides the only access lay through the hand hole below the tuyere casing. All the work must be done from the face.

The blacksmith cut a threaded hole in the center of the plate, which was to serve as a patch and screwed into that a strong eye made at the forge of a ½-in. bar. This served as a handle and as an anchor for clamping. The patch was then heated and carefully fitted to the surface surrounding the hole. By manipulation the patch was easily made to lie against the inside of the jacket. It was then securely clamped into place, and a row of holes slightly smaller than a ½-in. bar drilled through the overlapping edges around the hole. Without removing the clamps short ⅜-in. bolts were drawn through these holes by means of a slender wire which could be guided through the jacket and around the tuyere case to the hand hole. After all the bolts had been supplied with



PATCH IN PLACE

nuts the clamps were removed, and the patch loosened enough to admit a thick coat of luting between the overlapping edges. The nuts were then drawn down securely, leaving the patch in place, and a row of protruding bolts around the edge. These bolts were then removed, one at a time, a thread with a strong taper cut in each hole, and a plug, prepared by threading the end of the ½-in. bar, inserted. The plugs were driven in hard with a pipe wrench. The plugs which held the patch securely in place were finally cut off flush with the surface, and also the eye in the center of the patch. After the surface had been trimmed with file and emery cloth the job was complete. An offer to insert a piece of trimmed plate exactly to fill the depression was declined as unnecessary. Although the jacket was kept under observation for three months no adhesion of any kind was ever detected. The furnace was out of commission less than 24 hours. BROMIDE.

Denver, Colo., Jan. 15, 1907.

Increase of Moisture in Coke Shipped in Sealed Cars

I am greatly interested in the question discussed in the correspondence on "Increase of Moisture in Coke Shipped in Sealed Cars," in the JOURNAL of Feb. 9. Mr. Page's theory of the slow combustion of hydrogen is extremely ingenious, and since it has no rival, I suppose it has the field to itself. No doubt we should be duly thankful to its author, for it is an explanation of a mystery which has bothered many.

Yet, a number of us here are from Missouri, and if Mr. Page has no objections we shall reserve full acceptance until we have asked a few questions:

In the test described, how was the coke sampled for moisture before and after shipment?

What method for the estimation of moisture was employed?

How was the coke dried after quenching?

Is an excess of water commonly used in quenching? Theoretically, we presume, the evaporation of the water abstracts the heat from the coke, but after 212 deg. F. has been reached, this effect is no longer obtained, and the cooling water is likely to remain, even though the coke feels warm.

How much water will coke hold and still look dry? Charcoal, in appearance perfectly dry, will retain enormous quantities of moisture. STEEL.

Chicago, Feb. 12, 1907.

British-American Copper Mines and Smelter Company

A British Columbia mine manager has sent me from Montreal, Quebec, a copy of the New York *World* of Sunday, Jan. 20, with a half-page advertisement marked for my notice. Today an official of the Provincial Government informed me that the lieutenant-governor had received an inquiry concerning the alleged mining company, to which the advertisement invites public subscription for its stock. The advertisement is too long for me to deal with its details *seriatim*, at present, but I shall be glad to have you favor me with space in the JOURNAL for a few comments on its more glaring mis-statements.

The company concerned is advertised as "The British-American Copper Mines and Smelter Company," and its "copper property" is described as being "situated in the Golden division of the East Kootenay mining district, Province of British Columbia." I note some of the misrepresentations, as under:

"The richest copper district in the world."

The total value of the copper output of the whole of the adjoining mining divisions of Golden and Windermere for five years, 1901-5, is shown in the "Annual Reports of the Minister of Mines for British Columbia," to have been, at New York yearly average market prices, $4179. Of this amount $1654 was for 1905. The returns for 1906 have not yet been received by the Bureau of Mines, but they are not expected by the officials to show any increase worth noting.

"This mine will begin shipping ore at once." "All that we need to do to bring this mine into the producing class is to finish the construction of three miles of a ten-mile wagon road. . . . " "This will give us a splendid outlet to the Kootenay Central Railway."

The Kootenay Central Railway is not yet in existence, save only that some ten miles of grading has been done, but not within 50 miles of the mineral claims in question. Nor is there any reasonable probability of construction being shortly proceeded with. No operating railway passes within say 100 miles of these claims.

"The Granby Company, a neighbor of ours, is paying 24 per cent. yearly on a capitalization of $15,000,000."

The mines of the Granby Company are situated nearly 200 miles away in an air line. By ordinary transportation routes it would take about three days' travel by train and lake steamer to reach the Granby mines from this part of Golden district.

E. JACOBS,
Editor *B. C. Mining Record.*

Victoria, British Columbia, Jan. 29, 1907.

Brazilian Manganese Ore

On page 437 of Volume XIV, 1905, of THE MINERAL INDUSTRY under the heading "Analysis of the World's Manganese Ore," there is a reference to my manganese ore which is not correct. This mine is the only one situated in the district of Miguel Burnier which exports manganese ore to Europe and United States. I enclose an analysis of the ore.

	Per cent.
Silica	1.39
Peroxide of Manganese	74.79
Protoxide of Manganese	5.96
Peroxide of Iron	6.20
Alumina	2.37
Lime	Trace
Magnesia	0.67
Baryta	2.51
Phosphoric acid	0.075
Arsenic acid	0.046
Sulphuric Acid	0.050
Oxide of Copper	nil.
Oxide of Cobalt	0.080
Carbonic Acid	nil.
Combined Water	4.10
Alkali Potash and Soda	1.79
Phosphoric Acid	0.075
Phosphorus	0.033
Arsenic	0.030
Sulphur	0.020
Metallic Manganese per cent.	51.90
Metallic Iron per cent.	4.31
Silica	1.39
Moisture	16.33

CARLOS WIGG.

Rio de Janeiro, Dec. 17, 1906.

A discovery of wolfram in the northern territory of Australia is reported in the *Government Mining Journal of Queensland.* The wolfram is said to be associated with copper.

New Publications

"Einführung in die Metallographie." By Paul Goerens. Pp. 185; illustrated. 7x10½ in.; paper, 10 marks. Halle a. S., 1906: Wilhelm Knapp.

"The Treatment of Storage Batteries." By R. W. Vicarey. Pp. 60; illustrated. 8½x11 in.; paper. 2s. 6d. net. London, 1907: *The Electric Accumulator.*

"The Assay of Tin and Antimony." By L. Parry. Second Edition. Pp. 49; illustrated. 5½x8½ in.; cloth, 3s. 6d. net. London, 1906: *The Mining Journal.*

"The Cretaceous Flora of Southern New York and New England." By Arthur Hollick. Pp. 219; illustrated. 9x12 in.; cloth. Washington, 1906: Government Printing Office.

"Die Bekämpfung der Wassersand-(Schwimmsand-) Gefahr beim Braunkohlenbergbau." By Hermann Niess. Pp. 104; illustrated. 6½x10 in.; paper. Freiberg in Sachsen, 1907: Craz & Gerlach.

"Die elektrischen Oefen. Erzeugung von Wärme aus elektrischer Energie und Bau elektrischer Oefen." By Wilhelm Borchers. Pp. 168; illustrated. 7x10½ in.; paper, 7 marks. Halle a. S., 1907: Wilhelm Knapp.

"Geographic Dictionary of Alaska." By Marcus Baker. Second Edition. Prepared by James McCormick. U. S. Geological Survey, Bull. No. 299. Pp. 690. 6x9 in.; paper. Washington, 1906: Government Printing Office.

"A Review of Mining Operations in the State of South Australia during the Year Ended June 30, 1906." Issued by T. Duffield, Secretary for Mines. Pp. 24; illustrated. 6x9½ in.; paper. Adelaide, 1906: C. E. Bristow, Government Printer.

"Twenty-seventh Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior, 1905-6." By Charles D. Walcott, Director. Pp. 104; illustrated. 6x9 in.; paper. Washington, 1906: Government Printing Office.

"Graphite in Queensland, with Special Reference to the Mount Bopple Graphite Deposits." By B. Dunstan. Publication No. 203 of the Geological Survey of Queensland. Pp. 20; illustrated. 6x9½ in.; paper. Brisbane, 1906: George Arthur Vaughn, Government Printer.

"After Earthquake and Fire." Edited by T. A. Rickard. Pp. 194; illustrated. 6x9 inches, cloth. San Francisco, 1906: Mining and Scientific Press.

This little book is a reprint of the articles and editorial comment appearing in the *Mining and Scientific Press* immediately after the disaster at San Francisco, April 18, 1906. In a graphic way it portrays how our contemporary ably surmounted the difficulties following the great catastrophe. As such it is a highly interesting editorial record. The various papers which make up the bulk of the book are a collection which will have a permanent scientific value. Prepared by the competent hands of its well known editor, the book is not only an interesting record, but also is interesting reading.

Patents Relating to Mining and Metallurgy

UNITED STATES

The following is a list of patents relating to mining and metallurgy and kindred subjects, issued by the United States Patent Office. A copy of the specifications of any of these will be mailed by the ENGINEERING AND MINING JOURNAL upon the receipt of 25 cents. In ordering specifications, correspondents are requested to name the issue of the JOURNAL in which the notice of the patent appeared.

Published Week Ended Jan. 22, 1907.

PROCESS OF TREATING REFRACTORY ORES—Leslie V. Atkinson, Carshalton, England. No. 841,657. Filed Mar. 26, 1906.

RECUPERATIVE FURNACE—Frederick Bredel, Milwaukee, Wis. Nos. 841,663, 841,664. Filed Oct. 11, 1905.

APPARATUS FOR GRINDING AND SEPARATING FINE MATERIALS—Thomas A. Edison, Llewellyn Park, Orange, N. J. No. 841,677. Filed Jan. 29, 1903.

BRIQUET AND PROCESS OF MAKING THE SAME—Jacob S. Robeson, Camden, N. J., assignor to Robeson Process Company, Camden, N. J. No. 841,718. Filed June 9, 1906.

ELECTROLYTIC APPARATUS—John H. Ryan, Portland, Oreg. No. 841,720. Filed Mar. 1, 1906.

PROCESS OF TREATING ORES—John H. Ryan, Portland, Oreg. No. 841,721. Filed Mar. 1, 1906.

PRODUCTION OF ALKALI METALS—Geo. O. Seward and Franz Von Kügelgen, Holcombs Rock, Va. No. 841,724. Filed Apr. 23, 1906.

CINDER-MILL—William W. Sly, Cleveland, O., assignor to The W. W. Sly Manufacturing Company, Cleveland, O. No. 841,728. Filed Mar. 21, 1905.

KILN—Gustav Larson, Los Angeles, Cal., assignor to Los Angeles Pressed Brick Company, Los Angeles, Cal. No. 841,789. Filed Feb. 21, 1906.

TUBULAR BALL-MILL—Max F. Abbé, New York, N. Y. No. 841,841. Filed Sept. 21, 1906.

KILN—Paul Chmelewski, Helsingfors, Russia, assignor to Anna Mathilda Chmelewski, Helsingfors, Finland, Russia. No. 841,847. Filed Aug. 23, 1906.

HOISTING APPARATUS—Charles H. Hunt, New York, N. Y. No. 841,870. Filed July 24, 1906.

MANUFACTURE OF NITROGLYCERIN—Frederic L. Nathan, James M. Thomson, William Rintoul, and Andrew Scott, Waltham Abbey, England. No. 841,886. Filed June 5, 1906.

PEBBLE-MILL—Max F. Abbé, New York, N. Y. No. 841,913. Filed May 2, 1906.

COMBINED PULVERIZER AND SAMPLER—Oscar C. Beach and Arthur L. Buzzell, Los Angeles, Cal., assignors, by mesne assignments, to Frederick W. Braun, Los Angeles, Cal. No. 841,921. Filed Mar. 21, 1906.

MULTIPLE RIFFLE-SAMPLER—Evans W. Buskett, Coffeyville, Kans. No. 841,928. Filed July 20, 1906.

DESICCATING PLANT—Ernst W. Cooke, New York, N. Y., assignor, by mesne assignments, to the Cokel Company. No. 841,939. Filed May 20, 1904.

PROCESS OF TREATING GOLD AND GOLD-SILVER ORES—John A. Just, Syracuse, N. Y., assignor to the Just Mining and Extraction Company, Syracuse, N. Y. No. 841,983. Filed Jan. 27, 1906.

AMALGAMATOR—Henry L. Lightner, San Francisco, Cal., assignor of one-third to William Priest and one-third to Henry Feige, San Francisco, Cal. No. 841,990. Filed Feb. 23, 1906.

DUMPING-CAR—Francis Peteler, Minneapolis, Minn. No. 842,008. Filed Sept. 29, 1906.

ELECTRIC MELTING OR REDUCING FURNACE—Gilbert C. Landis, Carlisle, Pa., assignor to American Phosphorous Company, Camden, N. J. No. 842,099. Filed Sept. 21, 1904.

METHOD OF TREATING ORES—Charles A. Diehl and William Koehler, Cleveland, O. No. 842,139. Filed Mar. 28, 1906.

Published Week Ended Jan. 29, 1907.

HYDROCARBON ROCK-DRILL—John V. Rice, Jr., Bordentown, N. J. No. 842,246. Filed May 27, 1904.

PROCESS OF CONCENTRATING ORES—Alfred Schwarz, New York, N. Y., assignor to Schwartz Ore Treating Company, Phoenix, Ariz. No. 842,255. Filed July 19, 1905.

INGOT-STRIPPER—Clarence L. Taylor, Alliance, Ohio, assignor to The Morgan Engineering Company, Alliance, Ohio. No. 842,266. Filed Apr. 18, 1906.

PROCESS OF REDUCING COMPOUNDS—Frank J. Tone, Niagara Falls, N. Y. No. 842,273. Filed Dec. 16, 1905.

DREDGE—James L. White, Milwaukee, Wis., assignor of one-half to Edward L. Leser, Milwaukee, Wis. No. 842,364. Filed Oct. 4, 1905.

GOLD-DREDGE—Horace J. Clark, Boise, Idaho, assignor to The Clark Dredging Company, Chicago, Ill. No. 842,383. Filed Apr. 9, 1906.

TAILINGS-TRIMMER—Horace J. Clark, Chicago, Ill., assignor to The Clark Dredging Company, Chicago, Ill. No. 842,384. Filed Sept. 15, 1906.

MAGNETIC ALLOY—Robert A. Hadfield, Sheffield, England. No. 842,403. Filed Nov. 8, 1906.

GAS-FURNACE—Henry A. Schneibach, Pittsburg, Pa., assignor to Macbeth-Evans Glass Company, Pittsburg, Pa. No. 842,427. Filed Aug. 6, 1906.

PULVERIZER—Peter L. Simpson, Chicago, Ill., assignor to Herbert S. Simpson, Chicago, Ill. No. 842,430. Filed July 24, 1905.

COAL-MINE TIPPLE AND SCREEN PLANT—William R. Wilson, Toronto, Ontario, Canada. No. 842,439. Filed June 23, 1905.

PROCESS OF MAKING FERROUS CARBONATE—Adolf Flügge, Hanover, Germany. No. 842,452. Filed Nov. 15, 1906.

PROCESS OF MANUFACTURING SODIUM PERBORATE—Otto Liebknecht, Frankfort-on-the-Main, Germany, assignor to The Roessler & Hasslacher Chemical Company, New York, N. Y. No. 842,470. Filed Feb. 7, 1906.

PROCESS OF MAKING ALKALI PERBORATES—Otto Liebknecht, Frankfort-on-the Main, Germany, assignor to The Roessler & Hasslacher Chemical Company, New York, N. Y. Nos. 842,471; 842,472; 842,473. Original application filed Feb 7, 1906. Divided and this application filed Oct. 26, 1906.

ART OF CONSTRUCTING RETAINING-WALLS—George W. Jackson, Chicago, Ill. No. 842,552. Filed June 12, 1906.

MAGNETIC SEPARATOR—Charles J. Reed, Philadelphia, Pa. No. 842,583. Filed Aug. 15, 1902.

DEVICE FOR USE WITH ROCK-DRILLING MACHINES—Eustace M. Weston, Johannesburg, Transvaal. No. 842,598. Filed Oct. 30, 1905.

CONVEYER—John H. Bell, Haddonfield, N. J. No. 842,611. Filed Oct. 1, 1906.

APPARATUS FOR SEPARATING MATERIALS—Talmadge Blass, Lebanon, Pa. No. 842,614. Filed Oct. 28, 1905.

MOUNTING FOR ROCK-DRILLS—Martin Hardsocg, Ottumwa, Iowa. No. 842,654. Filed July 12, 1904.

BLAST-FURNACE—Hiram W. Hixon, Victoria Mines, Ontario, Canada. No. 842,663. Filed Aug. 1, 1906.

AUTOMATIC MINE-CAR SWITCH—Maurice O. Horning, Broughton, Pa. No. 842,667. Filed Nov. 1, 1906.

MINE-CAR—Charles A. Keller, Rosedale, Ind. No. 842,670. Filed Apr. 11, 1906.

COB BREAKER OR CRUSHER—George H. Mayne, Springfield, Ohio, assignor to The Foos Manufacturing Company, Springfield, Ohio. No. 842,681. Filed Mar. 19, 1904.

ORE HEATING AND DRYING DEVICE FOR FURNACES—Utley Wedge, Ardmore, Pa. No. 842,736. Filed Feb. 14, 1906.

PROCESS FOR COOLING COKE—Charles E. Arnold, Wilmington, Del., assignor of one-fourth to William Coyne, Wilmington, Del. No. 842,747. Filed Aug. 30, 1906.

MANUFACTURE OF STEEL—José de Moya, Paris, France, assignor to La Société de Moya et Cie., Paris, France. No. 842,802. Filed Feb. 7, 1905.

IDLER FOR BELT CONVEYERS—John J. Ridgway, Rosebank, N. Y. No. 842,813. Filed Apr. 3, 1906.

PROCESS OF BURNING CEMENT—Charles A. Matcham, Allentown, Pa. No. 842,848. Filed Dec. 28, 1906.

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

F. A. Heinze is again in Butte, Mon., having returned from the east.

F. H. Summeril, of Denver, is making examinations in Summit county, Colorado.

Bert McFarland, of Pittsburg, Penn., is in Gilpin county, Colo., looking after mining interests.

S. A. Weston, of Idaho Springs, Colo., has gone to Boston, Mass., to attend to mining business.

G. E. Alexander returned to Denver, Colo., recently, from a professional trip to California and Arizona.

Charles Stevens, of Boise, Idaho, has been making a visit to Clear Creek and Gilpin counties, Colorado.

H. F. A. Riebling has completed his testing work in northern Texas and has returned to Colorado Springs.

Leslie A. E. Swinney left London on Jan. 19 on his way to join the staff of the Broomassie mine, West Africa.

Col. A. G. Brownlee, of the Stanley mines in Clear Creek county, Colo., is making a visit to eastern points.

W. L. Cobb, of Sansalito, Cal., is at present engaged in making some mine examinations in Durango, Mexico.

James W. Neill, of Pasadena, Cal., consulting engineer for the East Butte Company, is visiting Butte, Montana.

David H. Lawrance, of Denver, is visiting several properties in Summit county, Colo., of which he is consulting engineer.

H. T. Keltie, of Joliet, Ill., president of the Washington-Joliet Company, is in Breckenridge, Colo., visiting the property.

J. Parke Channing, of the Tennessee Copper Company, and expert for the Lewisohns, is in Butte, Mon., on business.

F. J. Pope, a graduate of the Kingston School of Mines, has gone to Chile to examine a mine for the Guggenheim interests.

H. Hohman, of Milwaukee, Wis., has been looking over mining interests in the Eldora district, Boulder county, Colo., recently.

Clarence Beall, of Idaho Springs, Colo., has gone to southern California on a two months' trip to look at some copper properties.

A. J. Mueller, of Pittsburg, Penn., has returned east after a visit to Idaho Springs, Colo., to look after mining interests.

Robert Callow, Jr., of Idaho Springs, Colo., has left for Hillsboro, N. M., where he will assume charge of some mining property.

Foster Hewett, of Pittsburg, Penn., is on his way to Mexico, to do some professional work in the States of Jalisco and Durango.

A. A. Brady, of North Attleboro, Mass., has been in the Empire district, Clear Creek county, Colo., looking after mining interests.

L. E. Tobias, of Idaho Springs, Colo., has returned from a professional visit to mining districts in the southern portion of Colorado.

H. P. Dickenson, general manager of the Hoosac tunnel in Clear Creek county, Colo., has returned from a business visit to Chicago.

C. L. Fichtel, of the electrical department of the Calumet & Hecla Mining Company, at Calumet, Mich., is visiting New York.

H. W. Hardinge has returned to New York from a trip to Georgia, and has left again, to investigate some mines at Cobalt, Ontario.

D. A. McDonald, dredgemaster for the Reliance Dredging Company, of Breckenridge, Colo., has returned to that place from California.

G. A. Duncan, of Denver, Colo., is opening some mines in Eldorado cañon. His address for the present is Nelson, Lincoln county, Nevada.

Charles S. Walter, vice-president of the Security Investment and Mines Company, has returned to Denver, from an extended business trip to the East.

R. B. Binsmade is making examination of mines in Socorro and Grant counties, in New Mexico; also in Santa Cruz and Pima counties in Arizona.

Chas. W. Howbert, of Colorado Springs and Cripple Creek, Colo., has left for his new position as manager of the Cieneguita Copper Company's properties in Mexico.

Juan F. Brandes arrived in Denver a few days ago, after a prolonged stay abroad, and is at present on his way to Mexico on professional business, stopping in California.

E. J. Frantz, formerly of Silver City, N. M., and New York, has been appointed superintendent of the mine and mill of the Indian Valley Mining Company, at Greenville, California.

David Ellis, manager of the Pittsburg Consolidated Company, of Idaho Springs, Colo., has gone to Pittsburg, Penn., to attend a meeting, and may extend his trip across to England.

Edwin Higgins, mining engineer, has returned to Butte, Mon., after spending several weeks in New York on business connected with the Butte Knickerbocker Mining Company.

L. A. Desy, of Montreal, has left for India, having received from the Indian Government the appointment of superintendent of the dredging of the Jhelum river, in Cashmere.

A. E. Keables, president of the Security Investment and Mines Company, of Denver, Colo., has returned from a trip of inspection of some of the company's holdings in South Dakota.

Walter F. Lineberger and Lloyd A. Rone, forming the firm of Lineberger & Rone, mining engineers, have moved their offices from Pedriceña to Torreon and their address is now Torreon, Coahuila, Mexico.

In our issue of Jan. 28, page 211, reference was made to "J. A." Traylor, in connection with the Tri-Bullion Mining Company. It should, of course, have been "S. W." Traylor, president of the Traylor Engineering Company.

Herbert G. Cannon, of Goldfield, Nev., is in New York on business connected with some Nevada mining properties, which he recently examined for New York parties. He leaves shortly to examine mines in Durango, Mexico.

S. B. Tyler has resigned his position as superintendent of the San Luis Mining Company, at San Gabriel, Durango, Mexico, with which he has been connected for the past five years, to take charge of the mines of the Jimulco Mining Company, at Otto, Coahuila, Mexico.

Bertram Mellon has resigned charge of the operations of the Slough Creek, Ltd., at its deep-drift gold mine, Cariboo, British Columbia, and is proceeding to New Zealand on a trip through the mining districts of that country before returning to England. His successor at the Slough Creek mine is H. H. Water, who recently arrived from England.

L. M. Hartzell has been appointed superintendent of the bessemer department of the Homestead works of the Carnegie Steel Company, to succeed E. G. Weisner, who has been made general superintendent of the bessemer steel plants of the company at Bellaire and Mingo Junction, Ohio. Mr. Hartzell was formerly assistant to Mr. Weisner at Homestead.

J. L. Parker, at one time manager of the North Star mine, East Kootenay, British Columbia, and for the last two years manager for the Brown-Alaska Company of New York, with mines at Hadley, Prince of Wales Island, southeast Alaska, and Portland Canal, British Columbia, has retired from the latter position and opened an office at Seattle, Washington, as a consulting mining engineer.

Obituary

John Phillips, a pioneer iron manufacturer of Pittsburg, died at his home in Carrick, Penn., aged 84 years. When a young man he and his brother James formed a copartnership in the building and contracting business, erecting some important buildings in Pittsburg and vicinity. About 1860 he joined the late William J.

Lewis in establishing a bolt factory. In 1863 the late Henry W. Oliver became a partner and the firm was then Lewis, Oliver & Phillips. After Mr. Lewis withdrew from the firm it was styled Oliver Brothers & Phillips, which later gave way to the Oliver Iron and Steel Company, of which Mr. Phillips was vice-president. The mine-supply department of this enterprise was bought by Mr. Phillips and his nephew, John Phillips, was established in a separate plant, and when Mr. Phillips retired from active business in 1900 it was incorporated as the Phillips Mine and Mill Supply Company.

Societies and Technical Schools

Montana Society of Engineers — The twentieth annual meeting was held in Butte, beginning Jan. 10. The first day was devoted to an inspection of the Washoe reduction works at Anaconda, and Jan. 11 to a visit to the Montana School of Mines and the Boston & Montana plant. On Jan. 12 the business meeting was held and the following officers declared elected for the ensuing year: President, E. C. Kinney; first vice-president, Archer E. Wheeler; second vice-president, Arthur H. Wethey; secretary and librarian, Clinton H. Moore; treasurer and member of the board of managers of the Association of Engineering Societies, Samuel Barker, Jr.; trustee for three years, Azelle E. Hobart. President Dunshee retiring, President-elect Kinney commenced the duties of his office by making a short speech of acceptance. The annual reports of the secretary and treasurer were then read and referred to the trustees. The committee on resolutions on the death of the late Geo. H. Robinson presented resolutions of regret, which were adopted.

A communication from President Bowman, of the State School of Mines, was next, having for its object the establishment of a Montana Geological Survey by legislative enactment. After discussion the paper was referred to the trustees, with instructions that they present a report on the same. The address of the retiring president, B. H. Dunshee, was delivered. Prof. A. N. Winchell, of the State School of Mines, gave a very interesting account of some experiments on the genesis of copper ores, and Prof. Geo. W. Craven, of the State School of Mines, presented a thesis on concrete and its practical uses. A short discussion closed the exercises of the afternoon. The usual banquet completed the work of the annual session.

Industrial

Princess furnace, formerly operated by the Princess Iron Company, at Glen Wilton, Va., has been sold to Matthew Addy & Co., of Cincinnati.

The Warwick Iron and Steel Company has leased Anvil furnace, previously operated by the Glasgow Iron Company, of Pottstown, Pennsylvania.

The Sullivan Machinery Company, of Chicago, has established a branch office in Birmingham, Ala., where rock drills and other machinery will be carried in stock.

In order to meet the demands of their rapidly extending business, W. S. Barstow & Co., of New York, and Portland, Ore., have recently enlarged their power-plant department. At the head of the department is Perry West, recently with the New York Edison Company. Associated with him are Carl F. Schreiber and Rulof Klein.

The Piqua Blower Company of Piqua, Ohio, is being incorporated with a capital of $50,000. This corporation will take over the interests of the Piqua Foundry and Machine Company, and will make a specialty of positive blowers and gas exhausters as developed by the latter company in the past two years. It was necessary to effect this re-organization in order to take care of the large volume of business offered.

Trade Catalogs

Receipt is acknowledged of the following trade catalogs and circulars:

A. Leschen & Sons Rope Company, St. Louis, Mo. "St. Louis Today." Pp. 96; illustrated; paper; 10x13 in. 1907.

Ohio Brass Company, Mansfield, Ohio. Monthly Bulletin. Vol. 2, No. 6. Pp. 12; illustrated; paper; 6x9 in., Jan., 1907.

Arthur Koppel Company, Machesney Building, Pittsburg, Penn. Map of Eastern and Middle-Western States. Paper, 13x20 in.

Wellman-Seaver-Morgan Company, Cleveland, Ohio. Circular No. GP-i. Hughes Continuous Gas Producers. Pp. 32, illustrated; paper; 6x9 in.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 74. Engine Type Alternating Current Generators. Pp. 11, illustrated, paper, 7½x10 in. January, 1907.

Utah Mining Machinery and Supply Company, Salt Lake City, Utah. Bulletin No. 300. Callow's Traveling Belt Screen. Pp. 21; illustrated; paper; 8½x10½ in.; Jan., 1907.

Robins Conveying Belt Company, Park Row building, New York. Bulletin No. 16. Robins Conveying Machinery as Applied to Ore Handling. Pp. 24; illustrated; paper; 6x9 in.

Ingersoll-Rand Company, 11 Broadway, N. Y. Catalog H 36. Ingersoll-Sergeant Class "H" Air and Gas Compressors. Pp. 64, paper, 6x9 in. Form 45 A. Ingersoll-Rand Rock Drills. Form 35D. Air and Gas Compressors. Pp. 20, illustrated, paper, 3x5½ in.

Westinghouse Electric and Manufacturing Company, New York Life building, Chicago, Ill. Folder No. 5. Westinghouse Motor-Driven Champion Blacksmith Blowers. Folder No. 10. Westinghouse Motor-Driven A. B. C. Disk Fans. Pp. 8; illustrated; paper; 3½x6 in.

Construction News

Silver Plume, Colorado—The Waldorf Mining Company is arranging to put in a wire-rope tramway at its mine. E. J. Wilcox, Silver Plume, Colo., is manager.

Gold Butte, Nevada—The Gold Butte Mines Company is preparing to install a stamp mill. Charles F. Porter, Keith block, Salt Lake City, Utah, is purchasing agent.

Empire, Colorado—The Empire Tunnel Company is figuring on the installation of an electrical power plant for the more economical operation of its property on Covode mountain, near Empire. Address, Empire, Clear Creek county, Colorado.

Millersburg, Kentucky—The Kentucky Mining and Development Company, principal address 519 Madison avenue, Covington, Ky., has recently been incorporated with a capital of stock of $100,000 for the purpose of developing lead deposits near Millersburg, in Bourbon county, Kentucky. A mill building about 60x75 ft. will be erected and equipped at an approximate cost of $15,000, and estimates are desired on a concentrating plant of 100 tons daily capacity. Louis Fritz is the president of the company.

Montreal, Canada—The contract has been let to the Canadian White Company, of Montreal, for the construction in that city of a large cement plant to be operated by the Fordwick Company, of New York, which is largely controlled by the same interests as the Shawinigan Power Company. The plant will have an initial capacity of 2500 bbl. per day. The special feature will be the utilization of electric power transmitted from the Shawinigan hydro-electric plant. Nearly 4500 h.p. will be employed, requiring about 100 motors of the alternating-current type, and carrying from 10 to 150 h.p. each to operate the machinery. The works are to be in operation by August.

Montreal, Canada—The Laprairie Brick Company, near Montreal, which manufactures bricks from shale, is largely increasing its plant with the object of bringing it up to a capacity of 300,000 bricks daily. Included in the new equipment is a plastic brick machine, having a daily capacity of 150,000 bricks. An order has been placed with Allis-Chalmers-Bullock, Ltd., for induction motors of 500, 30 and 15 h.p., respectively, to operate the electric equipment. The property of the company is 125 acres in extent, from 12 to 15 of which is occupied by the plant. The shale which outcrops on the surface is of unknown depth, boring for 1000 ft. having failed to find the limit.

Special Correspondence

San Francisco Feb. 6

The Los Angeles Chamber of Mines has fully organized for the work of promoting and protecting the mining industry in the Southwest. John R. Mathews, president of the State Bank and Trust Company, has been elected president. A committee on investigation and reports on mining properties has been appointed, including E. W. Gilmore, H. Z. Osborne, W. H. Wilson, Charles M. Shannon and R. King. There are also committees on mines and mining, manufacturing, commercial and mercantile affairs, transportation and laws. The present membbership is about 200.

The Anti-Débris Association denies that its proposed injunction suits against the Oroville dredge men amounts to a general attack on the gold-dredging industry. They say that they only want restraining works which will prevent any silt resulting from the operations from entering the Feather river. The dredge operators all profess to be complying with the law.

A new dredging field is expected to be opened along Honcut creek, four miles from Honcut, Butte county, where considerable prospecting has lately been going on. A number of farms along the creek have been bonded for dredging purposes. There has been no dredge mining in that locality thus far.

A plan is being favored by the independent oil companies in Santa Barbara county to market their own petroleum. According to the information given out the project calls for an independent steamship line to run from Santa Barbara and San Luis bay to San Francisco. The scheme includes the coöperation of the Midway Oil Company, near Bakersfield, the fuel to be carried by pipe line from the company's wells to tidewater at Monterey or Port Harford on San Luis bay.

At a meeting of the executive committee of the California Miners' Association this week the representatives of all the mining companies present agreed to pay $25 a year dues for each company, and an effort will be made to get all the prosperous mines of the State to join the association. Moreover, mining companies of Nevada and other neighboring States which have offices in San Francisco will also be asked to join and give strength to the organization.

From the desert comes the news that the Greenwater people believe that they are growing so rapidly that they need a county all to themselves, with Greenwater as the county seat. The town is now located in Inyo county and not far from the county line. If the citizens should decide to form a new county and should be given the necessary permission by the legislature, it would be natural to take a slice off Inyo county, and a slice off of San Bernardino county.

The legislature of California is asked by a joint resolution introduced in the senate by J. B. Curtin, of Tuolumne county, to put itself on record as opposed to the action of President Roosevelt in allowing the land frauds to interfere with patents on mining claims. In his recent message President Roosevelt touched on this matter and expressed the opinion that until new laws were drafted patents should be held up as they have been for the last three years. Mr. Curtin believes that this stricture should be removed from patents affecting honest mining claims. He does not mention Roosevelt in the resolutions, but contents himself with taking formal exception to the rules drafted by the Secretary of the Interior. These rules stipulate that "no final certificate, patent or other evidence of title shall be issued under the public-land law until an actual examination has been made upon the ground by a Government officer." The examinations of the last three years have not resulted in the issue of patents.

Assemblyman Geo. W. Root, of Nevada county, has devised a scheme to assist the hydraulickers of the mountains. The plan is to interest the Federal Government and thus obtain a sufficient number of large dredges to keep the navigable stream clear of débris, while at the same time Congress would provide for powerful pumping plants for the purpose of depositing the silt on the swamp lands, thus filling in a vast acreage of what is now worthless ground and rendering it fruitful. To make the proposition still more attractive the law, if finally passed, would require that a certain per cent. of returns from each cubic yard of dirt washed out should revert to the State, and that hydraulicking should be limited to the capacity of the dredges.

The California Ore Company has completed the purchase of the manganese deposits owned by J. H. Cook on Red mountain, between Potter and Redwood valleys, Mendocino county, the price being reported at several thousand dollars. The company will proceed with development work immediately, a crew of men having already been sent to the grounds.

Salt Lake City Feb. 9

At the annual election of the Blackbird Gold and Copper Company John E. DuBois was elected president; Charles J. North, vice-president; B. N. Lehman, treasurer; F. O. Frick, secretary; with F. B. Stephens, L. N. Morrison and M. F. Murray, directors. The minority shareholders have brought suit against the company to prevent the organization from disposing of the remaining bonds in the treasury, amounting to $156,700, at 10c. on the dollar, or $156,700, in addition to a bonus of stock. The property of the company is located adjoining the mine of the Newhouse Mines and Smelters Corporation in Beaver county.

The annual meeting of the Yankee Consolidated Mining Company resulted in the election of John E. DuBois, of DuBois, Penn., president; Judge J. E. Frick, of Salt Lake, vice-president; B. N. Lehman, of Salt Lake, treasurer; with H. C. Edwards, of Salt Lake, and Charles J. North, of Buffalo, N. Y., directors. C. J. Canfield, of Salt Lake, is secretary.

There appears to be a well founded report out to the effect that Samuel Newhouse may yet conclude to utilize the site, purchased some time ago, at Pelican Point, Utah county, for smelter purposes.

Word has been received from Gold Butte, in the southeastern part of Nevada, that the Gold Butte Mines Company, controlled by Salt Lake parties, has recently made some important developments in its Eureka property located near Scanlon's ferry, on the Colorado river. A drift from the bottom of an 80-ft. shaft shows a full face of ore assaying about $20 in gold. Ore taken from an open cut across a parallel vein for a distance of 8 ft. gave returns of $17.40 in gold. The company has acquired a millsite on the Colorado river, and will install a stamp-mill in the near future. Charles F. Porter, Keith block, Salt Lake City, is purchasing agent.

Nine mines paid dividends to the amount of $1,143,000 in Utah during January, as follows: Columbus Consolidated, $42,500; Daly Judge, $112,500; Century, $5000; Yankee Consolidated, $15,000; Beck Tunnel Consolidated, $40,000; Grand Central, $15,000; Victoria, $10,000; Utah, $3000; Utah Consolidated, $900,000.

Scranton Feb. 11

After raging for six months, the fire in the Warrior Run mine of the Lehigh Valley Coal Company has been extinguished. In that time several homes have been destroyed, a number of deaths caused and much sickness, due to the escaping fumes. This is the case where the entire surface collapsed in such manner that the gas escaped through the fissures into the houses and asphyxiated a number of people. The fire was subdued by flooding the workings. The water will now be pumped out.

No. 5 breaker of the Delaware & Hudson Company was destroyed by fire last week. It was located in Parsons, near Wilkes-Barre, and was valued at $100,000. The fire throws 1200 men and boys out of employment.

Owing to the long continued strike in the Morea colliery of C. M. Dodson & Co., the clerks in the store and offices have been pressed into service to provide coal for the boilers of the plant.

A number of men and mules were entombed, by a fall of roof, in No. 3 slope of the Cameron colliery, Shamokin, last week. The men managed to crawl out through the air-tubes, but with the mules the proposition was entirely different. Large shifts are working day and night to release the mules, and until that time

men are compelled to crawl through the air-holes with feed bags to keep them alive.

Dover, N. J. Feb. 9

Fire broke out in No. 5 shaft of the Richard mine on Jan. 31 and, besides destroying the head-house and part of the conveyer, caused a cave-in at the head of the slope which has resulted in the entire abandonment of operations. The loss to the Thomas Iron Company, the owner and operator, amounts to $50,000 and will be considerably more unless the efforts to renew pumping succeed before the entire mine is flooded.

The fire was discovered about 40 ft. from bank just after the day shift came up and is supposed to have been caused by some miner leaving his lamp among the timbering. The strong draft in the shaft fanned the blaze fiercely and the head-house and conveyer were also soon in flames. Within half an hour after the fire broke out the head of the shaft caved in and while this smothered the shaft fire it broke the pipes from the pumps and cut off the water supply. The head-house was entirely destroyed and with it a comparatively new electric crusher and the big dynamo which furnished light and power. The brick building containing the new electric double-hoisting engine was saved by hard work.

The work of cleaning out the debris from No. 5 was begun on Feb. 3 and it is hoped that after the shaft is repaired and the pipes re-connected the pumps at the foot of the slope may be started. There are about sixty chances in one hundred that the pumps will start under water. Should the attempt to start them succeed, Superintendent James Arthur says he will be raising ore again within a week; but if the flooded pumps fail to start, it will mean a shut-down of from four to six months until the company can secure and install new machinery and pump out the water.

No. 5 was a double-track shaft, the best of the four shafts in use at the Richard mine. It was equipped with the best modern machinery and the ore was not handled from the time it was shoveled into the skip until after being crushed it was dumped upon the cars. It was the deepest of the four shafts and the entire mine drained to it. Up to a few years ago, each of the shafts was pumped independently of the others and in all 16 pumps were necessary to handle the water. The company then put in two big pumps, each weighing 28 tons and capable of raising a 6-inch stream 1000 ft. perpendicularly. One of these could handle all the water, but the two were put in in case one should break down; that both should be lost by reason of the pipes breaking in the shaft was not anticipated. After the big pumps were installed the old ones were taken out of each shaft and shipped away so that the entire mine was dependent on the pumps in No. 5. The boiler-house got its water from the mine, too, and it was necessary after the fire to lay a 4-in. pipe line about a quarter of a mile to a small brook and set up a pump in the road to secure water for the boilers.

The Richard mine has been in operation about 50 years. It has been one of the best producing mines in New Jersey. For a number of years the Thomas Iron Company has secured from it more than 100,000 tons of ore a year. The output last month was 10,800 tons.

Toronto, Ont. Feb. 12

The Geological Survey of Canada announces that tinstone in a solid vein has been discovered by John Keddy at Lake Ramsay, three miles west of New Ross, in Lunenburg county, Nova Scotia. Samples received were assayed and proved to be cassiterite, containing 78 per cent. tin. The ore is found in semi-crystallized forms, disseminated through a vein of decomposed kaolinized pegmatite in granite. The vein has only been opened 12 ft. in depth and requires to be further developed to ascertain the economic value of the discovery. The region was examined in 1903 by E. R. Faribault, of the Survey, who reported the occurrence of valuable minerals there and recommended it as a promising field for prospectors. He will devote some time next summer to studying the deposits near New Ross.

Notwithstanding the cold weather there is a great rush of prospector to the Larder lake district. All the land on the lake shore has been staked and gold seekers are staking claims back from the lake in all directions, though the snow is quite deep. Grassy lake, six miles west of Larder lake, also attracts many. The total number of locations taken up in the district is roughly estimated at 1800. The route is by train on the Timiskaming & Northern Railway to Heaslip, a point about 30 miles north of New Liskeard, and thence 30 miles northeast by wagon road to Larder lake. Sleighs for carrying supplies can be procured for $7 per day. There are two stopping places on the road and a hotel is being put up on the southwest bay of the lake, which is about half finished. Indian dog teams are also used to some extent for the conveyance of supplies.

J. E. E. Leonard, of St. Rose, Quebec, who is largely interested in the smelter of the Montreal Reduction and Smelting Company now under construction near North Bay, Ont., states that the plant will be ready for operation by March. The company has already spent $800,000 on the enterprise.

The Dominion Power and Transmission Company, Ltd., capital $25,000,000, has obtained a Canadian charter of incorporation giving extended powers, including smelting by electricity and any form of manufacturing. The head office is in Toronto, and it is understood that the controlling interests are those of Mackenzie & Mann, of the Canadian Northern Railway.

A find of iron ore has been made by George K. Taylor in the Wiley properties in the Loon lake iron area, where explorations are being carried on for a large American syndicate. The deposit, which was found at a depth of 3 ft., is said to be the most extensive and best as to grade in the district, samples assaying 60 per cent. iron.

Cobalt, Ont. Feb. 11

Owing to the intensely cold weather matters have been rather quiet in the Cobalt camp during the last week or two. The temperature has latterly ranged between 30 and 40 deg. below zero, which has greatly interfered with out-door work. Shipments for the week ending Feb. 2 amounted to 262,484 lb., of which the Nipissing sent 222,484 lb. and 40,000 lb. came from the Buffalo.

London Feb. 2

In my letter last week I referred to the position of the Lloyd Copper Company, operating in the Bathurst district of New South Wales. I mentioned that with the present high price of copper, the directors had been able to make a small profit on very low grade ore, and pointed out that under present circumstances their policy was to persevere on the mine and on the adjoining property, recently purchased. At the meeting of shareholders, held this week, the directors had additional information to give which makes the position very much stronger. The £50,000 debenture debt is to be extinguished. For this purpose 30,000 new shares have been issued, and taken up, and it is confidently hoped that the profits of the mine will provide the rest of the money required. Moreover the directors stated that they intended to pay a dividend at the rate of 5 per cent. on the total share capital now issued—£280,000—in March. The great advantage of extinguishing the debentures is that they carried such a high rate of interest, 10 per cent. That the directors feel able to pay for part of the retirement of the debentures out of profits and also declare a dividend shows that the grade of the ore has materially increased. The information given, however, is not sufficient to form an opinion as to the grounds the directors have to go on. But as they are men of experience and position we will take their word. Another interesting fact in connection with the Lloyd company is that shares have been bought recently in Australia to a considerable extent, and that to meet the requirements of these new shareholders, two local directors have been appointed, one of them being the manager, W. H. Corbould.

The Coromandel mine in the Kolar district of Mysore, India, is to be closed down. This mine was an offshoot of the Champion Reef, which in turn was an offshoot of the Mysore Gold Mining Company. Very early in its career the lodes became poor, and in spite of several successive subscriptions of new capital, no payable ore has been found. It is now decided that no more development work shall be done, and that as soon as the ore known to exist is extracted the mine shall cease operations. The directors are about to acquire the Hosur property in the Dharwar goldfield, to which John Taylor & Sons and their companies are turning much of their attention nowadays. The Coromandel Company is therefore to be reconstructed once more, with the object of acquiring the new property, and providing £40,000 working capital.

Another of Messrs. John Taylor & Sons' companies has met with misfortune inseparable from mining operation during the past year. This is the Tasmania Gold Mining Company, which was formed three years ago to acquire a local company of the same name at Beaconsfield, Tasmania. The local owners had done well, and there were still large ore reserves in the mine, with every likelihood of the ore extending in depth. The difficulty was the water question. The mine was on a water course and the amount of pumping required was prodigious. One of the largest pumping plants in the world was put down by Hathorn Davey & Co., of Leeds, on the order of John Taylor & Sons. The complete plant was not finished until recently, and in the meantime an extraordinary flood occurred, which not only swamped the workings, but did great damage on the surface. In consequence the operation of the mine had to be suspended for some time, and the profits made have had to be spent on repairing the damage and providing additional means for combating the water difficulty. It is not anticipated that any further difficulties of this sort will be met with, when once the pumping plant is in full operation.

Johannesburg Jan. 24

If the stock exchange be taken as the barometer of the Rand, then there has been a distinct improvement in affairs during the past fortnight. Most of the shares have gone up, and a few of the "gilt-edge" shares show a marked advance. The chief reason for the improvement is the change of front of the Boer party (Het Volk) in the matter of Chinese labor. From the beginning they have been rabidly against the Chinese and have preached that the yellow men must be sent out of the country, no matter what happened. The Progressives have been so successful in their attempts to show what disaster would fall upon the country were the coolies sent away that Het Volk saw it was necessary to change their tactics. The Boers are opportunists. They now qualify their statements by saying that, while opposed to Chinese labor, they never intended to cripple the mining industry in any way; that before they would agree to the repatriation of the coolies they would find a substitute of some kind.

Save for one or two rabid extremists there are no politicians in favor of the repatriation of the coolies until some substitute is found. The public has concluded that the mines will not be wrecked by the banishment of the unskilled labor; that somehow or other a way out of the difficulty will be found. Hence the rise in shares.

Another reason for the better state of the market is the excellent output for December, namely 550,167 oz., valued at £2,336,961. This makes the total of gold produced in the Transvaal for 1906 worth £24,492,288. This amount will be far ahead of the United States or Australia, so that for the year 1906 the Transvaal is the greatest producer of gold in the world.

During the month of December there were at work on the Rand 8070 stamps, while in the outside districts there were 340 stamps at work, making a total of 8410 stamps for the Transvaal.

The number of indentured coolie laborers at work on December 31, 1906, was 52,889. The last batch of 2000 coolies reached Durban from China a few days ago. No more Chinamen will come to South Africa until the Transvaal decides the coolie question. It is interesting to note that the organization for recruiting Chinese in China is to be kept together, so that it looks as if the mining houses expected a favorable decision in regard to Chinese labor.

During December 20 companies declared outputs of over 10,000 oz. each, the premier position being taken by the Simmer & Jack, with an output of 24,659 oz., valued at £104,744. The Robertson comes next with an output of 20,768 oz., while the Robinson Deep is third with an output of 20,241 ounces.

The Bonanza mine, which was supposed to be dead six months ago, is still crushing, and in December it produced 2179 oz. gold, although only 35 of its 50 stamps were kept at work.

One of the features of the month was the interest taken in alluvial gold prospects, the most conspicuous concern being the Good Luck Syndicate, which has acquired farms south of Rustenberg. Supposing that a payable alluvial deposit does exist, the next problem is where to get the water. It is to be feared that this alluvial boom is simply another form of the inveterate tendency for gambling. Too little is as yet known of the alluvial prospects to say whether they will be successful or not. So little was known of one such prospect that the secretary did not really know whether it was east or west of Johannesburg.

General Mining News

Rogers-Brown Ore Company—This company has been organized under a West Virginia charter, with a capital of $1,000,000, with headquarters in the Monadnock block, Chicago. The purpose is to explore, develop and mine iron-ore properties, and to do a general ore business. The officers of the company are: President, Samuel A. Kennedy, general manager Iroquois Iron Company, Chicago; vice-president, D. T. Croxton, president Cleveland Furnace Company; secretary and treasurer, E. L. Billingslea, Rogers, Brown & Co., Chicago. The board of directors is as follows: D. B. Gamble, Cincinnati; W. A. Rogers, Buffalo, N. Y.; D. B. Meacham, Cleveland, O.; M. C. Armour, Chicago; Joshua Monroe, D. T. Croxton, and Samuel A. Kennedy.

ARIZONA

GRAHAM COUNTY

Arizona Copper Company, Ltd.—The directors had before them at their recent meeting the results for the year to Sept. 30, 1906, subject to final audit. After carrying to reserve a sum of £80,000 for capital outlay, etc., the surplus, including £11,874 brought forward from 1905, is £435,012. After deducting the preferential dividends, amounting to £24,531, a sum of £410,481 is left. The directors have resolved to recommend to the annual meeting, to be held on Feb. 18, the payment out of this sum of a dividend for the year 1906 of 5s. 3d. per share, free of tax, on the preferred ordinary and deferred ordinary shares. To account of this dividend 2s. 3d. per share was paid on July 26 last, and it is proposed that the balance of 3s. per share be paid on Feb. 27. This dividend absorbs £398,972, and the balance of £11,509 will be carried forward.

CALIFORNIA

AMADOR COUNTY

Chapman—The company owning this mine has had to pump out the old Square Head mine adjoining, to avoid the menace of the water to the old working of the Chapman.

Hercules Horse Shoe Group—These mines, in Indian Creek near Murphys, have not been worked for some time, and the timbers gave way, causing a cave which has exposed a body of ore 9 ft. in width, which prospects well. Machinery is soon to be added by the superintendent, W. R. Wyatt.

INYO COUNTY

Bishop Creek—At the mines of this company the snow on the level was 125 in. deep, two weeks since, and operations are retarded.

Furnace—Work on the various claims near Furnace is being pushed rapidly.

The Copper Blue claim of the Furnace Creek Company continues to show up well. The shaft is nearing the depth of 500 ft.; ore has been encountered at intervals the entire depth. The town of Furnace is growing and promises to be an important point.

Greenwater—The town of Greenwater is now completely moved from the Kunze townsite to that of Ramsey, though the town retains the name of Greenwater; it has a population of about 700. The Furnace Creek Copper Company is sinking two shafts with gasolene hoists; one is down 400 ft., and the intention is to continue down to 600 or 700 ft. before crosscutting to the vein which was opened on the 50-ft. level. The other companies in that section are all working, and the complaint of lack of laborers is frequently heard.

MODOC COUNTY

Bidwell—Everyone at Bidwell is satisfied that prospectors will get in the mountains a great deal earlier than last spring, as there is not so much snow. A great many locations will be made as soon as the snow melts and leaves the mountain bare. Four men are now at work on the Bidwell Discovery property, running the tunnel in on what was known as the Kafader property, and which is one of the main claims of the Bidwell Discovery Gold Mining Company. Machinery will be put in on the mill site in the spring to work the ore. The Fort Bidwell Consolidated Gold Mining Company has planned to do a great deal of work early in the spring.

MONO COUNTY

Masonic Mountain Gold Company—The new mill for this company, at Masonic, will be shipped from San Francisco as soon as the roads permit transportation.

NEVADA COUNTY

Boss Mine—The Bay Counties Company is building a line two miles in length to convey power from the Nevada-Colgate line to this mine near Sweetland. The Boss company is installing an electric plant, including compressor, hoist and pump.

Canada Hill—For the first time in many years this mine has been unwatered, and in a short time a full crew will be at work. The old property is being reopened by a company with A. A. Charronat in charge as superintendent. The shaft is 1300 ft. deep. Sinking will commence immediately and drifts will be run from the bottom of the shaft.

Brunswick Consolidated Gold Mining Company—At this mine, Nevada City, a body of high-grade milling ore is in sight, and the mill is being run to its full capacity. R. Gilman Brown is now president of the company.

PLACER COUNTY

Belleview—This property, near Ophir, has been sold for $30,000 to W. F. Byrne and associates of Los Angeles. The shaft is down 300 ft. Electric power is to be supplied to this mine, and the Gold Blossom and Eclipse, owned by the same gentlemen.

SAN BERNARDINO COUNTY

Highbinder Group—This group, at Vintrigger, has been sold recently to C. F. Spaulding of Idaho, who has set a force of men at work.

SAN LUIS OBISPO COUNTY

Van Ness Mining and Development Company—This company, owning 180 acres of mineral ground eight miles from Mono and 12 miles from Cayucos, on the coast, has started development work on several claims carrying in their ores gold, silver and lead.

SHASTA COUNTY

Mountain Monarch—There has been a great inrush of water at this mine, which is being very gradually overcome. A new body of ore has been met at the 700 station.

Rattlesnake—This mine, near Redding, is shipping 50 tons of quartz daily to the Mammoth smelter at Kennett, for fluxing purposes.

SIERRA COUNTY

Keystone—Work has been resumed at this mine, Sierra City, the snowslide having done but little damage.

SISKIYOU COUNTY

Blue Gravel—Impediments to clear title to this property, at Yreka, having been removed, a local company proposes buying it from H. E. Stratton, and starting it up.

TULARE COUNTY

White River District—W. T. Adams, of Corinth, Miss., has bought the Bald Mountain and Eclipse groups, and will put in air compressors, hoists and mills.

TUOLUMNE COUNTY

Mountain Mining Company—In the Mary mine, owned by this company, a good breast of ore is being opened on the 100-ft. level. W. A. Monroe, the superintendent, expects to add 20 stamps to the present five-stamp mill.

COLORADO

CLEAR CREEK COUNTY

Buffalo-Colorado—Buffalo and Detroit people have become interested in a lease and bond calling for $35,000 in two years on the Fraction, near Idaho Springs. J. W. Boyd, Idaho Springs, is manager. Machinery is being overhauled and heavy operations are planned.

Waldorf—Large ore-bins have been erected at the Wilcox tunnel and an aërial tramway will be built from the mine so that ores can be handled to the Argentine Central Railroad. E. J. Wilcox, Silver Plume, Colo., is manager.

Quartz Dike—Boston people have become interested in this company, having taken hold of the Weston property in Gilson gulch. S. A. Weston, Idaho Springs, is in charge of operations.

GILPIN COUNTY

Jefferson-Calhoun—Arrangements have been made to take over the East Calhoun property in Leavenworth gulch, and as soon as machinery is overhauled the 1100-ft. shaft will be unwatered. Consideration is not known. H. C. Eastman, Central City, is manager.

Old Town Consolidated—The annual report shows a production for 1906 of $268,849. New machinery is to be installed for deeper operations and three 75-kw. transformers have been ordered. G. K. Kimball, Jr., Idaho Springs, Colo., is manager.

Chicago-Carr—A four-drill air compressor of the Rand make has been ordered and sinking operations are planned. B. M. Myers, Central City, is manager.

Newhouse Tunnel—It is reported that operations may be suspended entirely at the breast of the Newhouse tunnel in the near future, unless some steps are taken by the owners of properties along the line of the tunnel in this county, to help pay the operating expenses, by reason of their properties being drained through the Newhouse tunnel workings. The Gilpin County chamber of commerce will take steps to get the tunnel and mine operators together to arrange some satisfactory basis. George Collins, Idaho Springs, is manager of the Newhouse tunnel.

Pewabic Consolidated—The tenth quarterly report shows gross production from Oct. 15 to Jan. 15 of $58,081. A large amount of development work has been performed. J. C. Fleschhutz, Central City is manager.

LAKE COUNTY—LEADVILLE

Musk Ox—On Long & Derry hill a new company, with John F. and George F. Campion at the head, has secured 160 acres of patented land at a place where the Iowa and Empire gulch road tops the hill, and about four miles in a direct line from the foot of Harrison avenue south, in Leadville. The district has been prospected on the surface and fair values in gold have been found in different veins. The shaft is now down a little over 100 ft. and is three-compartment, 4½x9 ft. in the clear; it is equipped with a modern plant of machinery and will be sunk to the blue lime before any prospecting is done for the ore-shoots. The company has erected commodious houses for the comfort of the men, and work will be pushed during the winter.

A. Y. & Minnie—After 28 years of strenuous mining this old stand-by is producing at the rate of 7000 tons of ore per month. The crude ore that is sent direct to the smelter amounts to 2000 tons per month, while the concentrates bring up the balance. Three grades of concentrates are made, the first and second being of zinc and the third a lead concentrate.

Settling tanks have been placed at different points below the mill, which catch all of the slimes; they are dried and shipped.

Water Problem—The water problem in the down-town section is being solved monthly to the satisfaction of all concerned. When the Penrose shaft was sunk the pumps were raising 2250 gal. of water per minute; today, with the connections made with the Coronado, the pumps are only lifting 1500 gal. per minute.

Morning and Evening Stars—In addition to the work being carried on by the company, 11 sets of lessees are at work on the different shafts, and the properties are shipping 400 tons per day of an excellent grade of iron. The men who recently secured a lease on the Crescent shaft have started to drift from the bottom into virgin territory. Outside of the iron that is being shipped a good tonnage of lead ore is going to the smelter.

Harrington Tunnel—This tunnel, in East Tennessee district, is now in 140 ft. and for the last 30 ft. has shown indications of mineral. When the parting quartzite is caught, it is expected that the orebodies will be exposed.

Leo Shaft—The last time this property, at the head of California gulch, was worked was in the early 80s by Joe Watson, and he sunk the shaft to a depth of 600 ft., when the inflow of water became so great that he had to abandon work. This was the first known water-hole in the camp. The shaft was sunk to catch the rich gold-bearing orebodies that were and are supposed to be at the head of the gulch. Since that time no work has been done on the property until a few weeks ago, when a lease on the ground, 20 acres, was secured by the Twin City Mining Company, composed of the principal owners of the Cloud City Mining Company operating in the down-town section. A first-class plant of machinery has been installed, and the shaft put in order; when this work is completed, drifting will start in an old drift 50 ft. above the bottom of the shaft. At this point there is a good streak of ore which will be followed with the hope that it will lead to the main ore channel.

Lord Byron—Iowa Gulch—This property is situated above the Lillian and the Florence, and on different occasions good bodies of ore have been opened, but were never permanent. Recently at a depth of 250 ft. in one of the drifts a good body of ore was caught which will run $30 per ton. The shoot dips rapidly and Fred Arnold, who has a lease on the ground, and is one of the owners, will sink the shaft another lift of 200 ft. At present he is installing heavier machinery, as he expects to strike a heavy flow of water.

Minerva—This property, Mosquito range, is located in Sacramento gulch, and it is claimed is the western extension of the London. The owners have been pushing work steadily on it during the winter, and last week opened up a good body of ore 3 ft. wide, which in every respect is the same as found in the London.

New Monarch—The rich body of ore recently opened in the Winnie workings, South Evans gulch, improves as work proceeds; enough has already been done on the ore-channel to prove that it is in place and permanent; the values still remain high in gold and silver and 8 per cent. copper.

MICHIGAN

HOUGHTON COUNTY—COPPER

Atlantic—F. McM. Stanton, the agent for the Atlantic property, returned from New York, and will examine the showing at section 16. Future plans with regard to development will be decided upon after examining the opening.

Rhode Island—A fourth shaft is to be started on the property of the Rhode Island Copper Company, but the exact location has not been definitely decided upon. At the present time there is one diamond drill at work on the Kearsarge lode. This method of proving the location of the lode has, however, proved generally unsatisfactory and the new shaft will be sunk instead.

Winona—Work has begun on the erection of the new compressor at Winona. The electric power house is now nearly completed.

KEWEENAW COUNTY—COPPER

Central—The old Central Mining Company, whose property was first opened in 1854 and closed down in 1898, is to be dissolved and application is soon to be made to the courts of Michigan to allow the company to wind up its affairs. There are about 250 stockholders, and these will probably receive a small dividend, about 75c. per share, to be declared after all outstanding debts have been paid. There is approximately $20,000 in the treasury. In 1905 the property was sold to the Calumet & Hecla Company.

ONTONAGON COUNTY—COPPER

Lake Copper Company—It is reported that four drill cores taken from the property of this company show good copper and the cores closely resemble the Baltic lode. If the strike proves to be on this lode, it will prove its continuity for 25 miles southwest of the Globe property, which heretofore has been the westerly point of this disclosure. The location of the supposed lode is to the east of the line of bluffs along which all the Ontonagon mines have been worked.

MISSOURI

RANDOLPH COUNTY

Randolph-Macon Coal Company—This company, which owns a large tract of coal land and several producing mines, failed to pay the interest due Feb. 1 on $2,000,000 outstanding bonds. The cause is said to be labor difficulties at the mines. J. T. Gardiner, of New York, is president.

MONTANA

BUTTE DISTRICT

Amalgamated—Car and coal shortage, with cold weather, have been interfering with the operations of this company for a month or more, and the end is not in sight. The Washoe smelter is not receiving more than two-thirds of its customary quantity of ore per day and the Boston & Montana plant is in a similar fix. Feb. 4 some 1900 tons were loaded for the latter, this quantity being all for which the railroad company could furnish cars, and next day only a little more was shipped. On account of the drawbacks the output of copper in Butte last month did not reach quite 25,000,000 lb., and will fall considerably short of this quantity this month. The Boston & Montana is still operating only three of its five blast furnaces. It has been short of coke for several weeks and is unable to secure more than enough to keep the plant running in part. It has 3000 tons in transit between Duluth and the plant and Fernie and the plant, but cannot locate it.

North Butte—This company is experiencing trouble similar to that of the others. It has lost several days recently by reason of inability to have its ore transported to the Washoe. Development work in new ground north of the opened veins is going ahead without interruption.

Reins Copper—This company is cutting a station south of the shaft at 1200 ft., to accommodate an 800-gal. pump. It has a 700-gal. pump on the opposite side of the shaft at the 1200, but the flow of water is heavy and the addition is for reserve work. It is shipping about two carloads of copper ore a week from the 900- and 1000-ft. levels, and driving east on the 1200 with a view of prospecting the Ella property, which it acquired recently for $240,000.

Coalition—Shipments of ore from the mines of this company during the last week have averaged only about 800 tons a day, 300 tons less than the regular quantity.

Cable Consolidated—This company has struck copper ore on the tunnel level and 200 ft. below this level, and has shipped five carloads to the Washoe. The ore carries an excess of iron, and is treated for practically nothing on this account, as it is valuable for mixing with the sulphide ores of Butte. The company has an abundance of gold ore in sight, and is operating a 30-stamp mill on it.

Butte & London—The company is cutting a station 68 ft. long at the 800, and will not finish it until late in February, after which it will install temporary pumps

and resume sinking to the 1500. Two pumps, each of which will have capacity for 1000 gal. of water per minute, will do duty in the mine, one on the 800 and the other on the 1500. The latter will throw to the 800 and the former to the surface. The pumps will not be delivered until spring. The company does not expect to strike commercial ore until it reaches 1500 ft. depth.

Butte & Summit Valley—Diamond drilling in the property of this company is progressing under the supervision of H. H. Taft, in the interest of Boston men, who are supplying the money for development. The drill is working in the face of the crosscut south of the 250-ft. station, and is making 25 or 30 ft. a day.

Davis-Daly Estates—Development on the property of this company is progressing, but no ore worth mentioning has been struck in any of the openings. The face of the crosscut south of the 1800-ft. station of the Original is in 1100 ft. A stringer has been cut in the Smokehouse claim.

United Copper Company—In order to simplify the capital account, it is proposed to retire the preferred stock. Holders of that stock are asked to exchange it for common, at the rate of 1¼ shares of common stock for each share of preferred.

PARK COUNTY

Montana Coal and Coke Company—The new plan of reorganization recommends the organization under the laws of Maine of a holding company to be known as the Montana Consolidated Coal and Coke Company, with a capital of 200,000 shares of stock, par value $10; an issue by the Montana Coal and Coke Company of New Jersey of $1,000,000 6 per cent. 20-year sinking fund new bonds, to be used for the retirement of the $500,000 outstanding bonds and for the payment of the company's floating indebtedness, which amounts to approximately $425,000, and the exchange of the present company's 200,000 shares of stock for the stock of the new corporation on a share-for-share basis, on the payment of $1 per share in cash, the proceeds thereof to be used to provide working capital. A special meeting of stockholders is called for Feb. 27. The new Montana Consolidated Coal and Coke Company has been organized by the election of the following officers: President, C. F. W. Dilliway; vice-president, Larkin T. Trull; treasurer, N. Willis Bumstead; chairman of the board of directors, H. M. Burton.

NEW MEXICO

GRANT COUNTY

Lost Bullion Spanish Mines Company—This company is operating extensively on the east slope of Bear mountain, 7 miles northwest of Silver City. It has recently purchased 1000 acres of mineral land in the Bear mountain mining district and is driving a double-compartment tunnel 1000 ft. to cut the contact and also to tap the old workings. It is also sinking a shaft on the line of the tunnel to open up the old workings and to use as an air shaft for the tunnel, and is working a force of men on a road grade leading from the mesa into the cañon where the tunnel is now being driven.

The old workings referred to were discovered to be old Spanish workings and up to the present time over 10 miles of these workings have been explored.

Shakespeare Camp—W. P. Black, president of the company owning the Shawmut copper mine, near Salida, Colorado, has just bought the Eighty-five mine for $75,000. This property fell into the hands of Roberts & Leahy, the Lordsburg merchants, some years ago for a debt of $3500, and since then has been quietly developed to its present showing.

Burro Mountains—If present appearances are not deceptive, this region is destined to be a big copper producer. The ore lies in lenses formed by stockworks and impregnations in the decomposed porphyry of the range. The copper appears above as malachite, but in depth changes to chalcocite coating pyrite crystals, as in Butte and Cananea. Bodies as long as 500 ft., with a maximum width of 50 ft., and of unknown depth, have been found with an average around 3 per cent. copper. The low grade prevented the previous exploitation of this camp, but for a year, since even 2 per cent. concentrating ore became desirable, the activity has been feverish.

There are now five strong companies, the Burro Mountain, the Tyrone, the National, the Copper Gulf and the Comanche. The first has only one working shaft, but has a 200-ton concentrator, 400-h.p. boilers and a mine with two years' development. The second company is sinking three shafts with air drills, and has 500-h.p. boilers. The claims of the National are in Whitewater cañon, and will ultimately ship to the Silver City Reduction Works, owned by the Comanche. A Norwalk air compressor of 350 cu.ft. capacity has been ordered by the National, for use in sinking its three shafts. The National is financed by St. Louis parties. The Copper Gulf Company is a new arrival, but has already begun two shafts, and has just received a new steam hoist and boiler. The two towns of the district are Leopold and Tyrone, from which a daily stage plies to Silver City. The Comanche will ship to its Silver City works, and has three shafts now open.

LINCOLN COUNTY

An event which may mean much to this region is the sale to English capitalists from London, of the Coruna Queen mine in the Gallinas mountains.

NEVADA

EUREKA COUNTY

Richmond-Eureka — During the last year $350,000 to $400,000 has been expended in putting the property of this company in good condition, and a further amount of about $125,000 has been provided for. During the last few months the company has been in a position to ship a great deal more ore than the railroads could handle. This company took over the property of the old Eureka Consolidated Mining Company and Richmond Consolidated Mining Company, which for many years were at loggerheads, the Richmond refusing to pay half the expense for pumping out the mines. The United States Smelting, Refining and Mining Company owns a one-third interest in the new company.

LYON COUNTY

Yerington Red Metal Company—This company now owns a group of claims in the Yerington district, on which development work is in progress. A considerable body of copper ore is already blocked out.

ESMERALDA COUNTY—GOLDFIELD

Rochester—A small talc vein has been cut which carries free gold. This mine is situated in the Diamondfield section of the field, and has several auriferous veins outcropping on the surface. The management is sinking to prospect these veins at depth and the present strike is looked upon as a good augury for the value of the veins which will shortly be cut at a depth of about 250 ft.

Combination Annex—A prospecting shaft on this property has disclosed a fine quartz boulder at a depth of 50 ft., which carries gold. It is believed to be connected with a vein in close proximity.

Jumbo-Extension—A strike of phenomenal richness which gives promise of rivaling the famous Hayes-Monnette lease has been made by the Higginson Leasing Company on the Wedge claim of the Jumbo-Extension mine. The strike was made in the vicinity of the Mohawk ground and the vein is over 9 ft. in width. It has been opened by shaft and incline and will give a good hight of backs.

Atalanta—Splendid specimen ore is being taken out of this 165-ft. level in the Union Jack claim. It is believed to be from a vein which has yielded good returns in the St. Ives mine. The leasing company has completed arrangements for increasing its mining facilities by sinking another shaft and erecting a more powerful hoisting plant.

Silver Pick—Three shifts are engaged in sinking the shaft, which is now 100 ft. in depth. The country is andesite, and is carrying stringers of quartz, which are in places mineralized. The lessees believe they will strike the ledge within a few weeks.

NYE COUNTY—TONOPAH

Boston—The management is rushing shaft-sinking operations, and is employing three shifts of miners. The shaft is 330 ft. in depth. On the 500-ft. level a crosscut is being driven south to locate the vein system developed in the Montana and North Star mines. This crosscut has been extended a distance of 245 ft. from the shaft.

West End Consolidated—A new prospecting shaft is being sunk at a point 800 ft. west of the old working shaft. It is at present 20 ft. in depth, but will be sent down to 500-ft. level.

Montana—The bad weather conditions are severely interfering with the erection of the new 40-stamp mill. When the weather moderates and the snow disappears a large force of mechanics will be engaged in order to complete the mill early in the spring. Development operations in the mine continue to be satisfactory.

Ohio—Arrangements have been made to resume sinking operations as soon as the fuel famine is overcome. The mine is now controlled by the West End Consolidated Mining Company.

WHITE PINE COUNTY

Nevada Consolidated Copper—A special meeting of this company has been called for Feb. 25, at Portland, Me., to vote on increasing the number of directors from nine to 11, and to vote on selling a half-interest in the Nevada Northern Railway to the Cumberland-Ely Copper Company and buying a half-interest in the Steptoe Valley Smelting and Mining Company.

OREGON

BAKER COUNTY

United Elkhorn—Development work is going on steadily on the 400-ft. level in this mine, 16 miles west of Baker City. The pumping plant has been repaired and is now in full operation. Edward I. Field is manager in charge.

PENNSYLVANIA

ANTHRACITE COAL

Delaware, Lackawanna & Western—This company has been experimenting with chemical fire engines for extinguishing fires in mines. The experiment was so successful that the company has equipped a number of the mines with 90-gallon engines. They are mounted on mine-car trucks and can be transported through the workings.

Lehigh & Wilkes-Barre—A serious fire occurred in No. 19 colliery of this company, at Wanamie, Feb. 8, as a result of which seven men lost their lives through suffocation. The fire broke out on the fourth lift, in the heavy timbers, and before the men could be notified the workings were filled with thick smoke. Owing to the heroic work of the miners first alarmed many lives were saved. Men went through the dense smoke to warn the miners and laborers in the chambers and assisted them to the shaft. Had each man looked after himself and first escaped, regardless of the fate of others, the loss of lives would have been very heavy. The cause of the fire is unknown.

Philadelphia & Reading Coal and Iron Company—This company's statement for December and the half year from July 1 to Dec. 31 is as follows:

	December	Half-year
Earnings	$3,968,230	$17,992,249
Expenses	3,621,895	17,097,209
Net earnings..	$346,335	$895,040

For the half-year there was a decrease of $110,465 in earnings; an increase of $210,811 in expenses, and a resulting decrease of $321,276 in net earnings.

BITUMINOUS COAL

Indianola Coal Company—J. V. Thompson, of Uniontown, Penn., and J. P. Brennen, of Scottdale, president of the Thompson-Connellsville Coke Company, have acquired a majority interest in the holdings of the Indianola Coal Company and the Allegheny & Western Connecting railroad. These corporations were organized by the late Selwyn M. Taylor to acquire and develop 7500 acres of Freeport coal near Harmarville, and to build a low-grade railroad to connect the West Penn, the Bessemer & Lake Erie and the Pittsburg & Western tracks by about 16 miles of track. The entire tract secured by Thompson and Brennen is underlaid with a vein of coal 7½ ft. thick. Two years have been spent in making tests which have shown it to be a coking coal second only to the best of the old Connellsville region. Its proximity to Pittsburg, only 12 miles by rail, gives to this field a high value.

COKE

Tower-Hill Connellsville Coke Company—Notice is given of the purchase of 2000 acres of coal territory near Uniontown, by a syndicate of Cleveland capitalists, for $3,400,000, and the formation of the Tower Hill Connellsville Coke Company, with a capital stock of $1,500,000 preferred, $4,000,000 common, and $2,500,000 in bonds, to develop the property. Arrangements are being made for the construction of 800 coke ovens which will be equipped with machines for drawing the product. The officers of the company are: George D. Howell, Uniontown, Penn., president; first vice-president, F. M. Osborn, Cleveland; second vice-president, J. V. Thompson, Uniontown; treasurer, Joseph R. Nutt, Cleveland; secretary and general manager, L. W. Fogg, Uniontown; assistant treasurer, John R. Thompson. Andrew Squires, of Cleveland, George H. Burr, of New York, and Lloyd G. McCrum are on the board of directors with the officers. A mortgage for $2,500,000 covering the property has been given by the new company to the Citizens' Saving and Trust Company, of Cleveland.

Pickands-Magee Coke Company—This Pittsburg company has changed its corporate name to the Pickands-Magee Company, and increased the capitalization from $100,000 to $200,000, all of which is paid in, and has also taken into the company several new interests in addition to buying out the interest of the Pickands-Brown Company, Chicago. The new organization last year controlled an output of 600,000 tons coke and 200,000 tons coal, and with the additions it expects to handle in 1907 at least 1,000,000 tons coke and 500,000 tons coal. Several of the smaller companies formerly controlled by the company have been merged into the Southern Connellsville Coke Company, of which George Whyel, of Uniontown, is vice-president and general manager, and this company, together with the Whyel Coke Company, controlled by George and Harry Whyel, is now a part of the Pickands-Magee Company, with both of these gentlemen, who are large operators, as directors. The Pickands-Brown Company, Chicago, will now devote itself entirely to the manufacture and sale of by-product coke manufactured at Milwaukee and South Chicago. The new officers of the Pickands-Magee Company are W. C. Magee, president and treasurer; Harry Whyel, vice-president; C. L. Boyle, secretary; C. S. Bygate, general sales agent. The new board of directors consists of the following: D. M. Clemson, Thomas Morrison, C. L. Doyle, Pittsburg; W. C. Magee, I. W. Semans, George Whyel and Harry Whyel, Uniontown.

BERKS COUNTY

Boyertown Ore Company—It is reported that the property of this company at Boyertown, including the iron-ore mines and mineral rights on 280 acres of land, has been sold for over $400,000 to Chas. M. Schwab, representing the Bethlehem Steel Company.

SOUTH CAROLINA

In his annual report to the governor Earle Sloan, State geologist of South Carolina, urges the importance of requisite provision for a reasonably comprehensive survey of the phosphate deposits with a view to establishing their value to the agricultural and economic interests of the State, and to provide such regulation of mining methods as will tend to eliminate the system of skipping, through which accumulations concentrated in pockets are exhausted, while intermediate deposits are greatly depreciated in value. The report states that the phosphate deposits of South Carolina are fast being consumed, and the equivalent of every ton exported will have to be returned at the cost of the consumer.

SOUTH DAKOTA

PENNINGTON COUNTY

Hymalulu—A tunnel will be driven on this property to a depth of 250 ft. to develop the vein already opened in apex workings. In the 70-ft. shaft a face of ore 28 ft. deep and 6 ft. wide has been exposed. The ore is a heavy concentrating material, carrying practically no free gold.

Bed Rock Placer—This corporation, owning 120 acres along Rapid creek, plans to install a dredge to be in operation by June 1. This dredge will have a capacity of from 2000 to 2500 cu.yd. daily. The large volume of water to be handled has heretofore prevented the exploitation of the ground.

Golden West—Work at the mill at Rochford, which has been suspended for two months, will now be resumed and carried on through the winter. It has been the custom to operate only during the summer months, on account of lack of water in cold weather, but with the recent change of ownership repairs and improvements have been made to insure a steady and constant water supply. Charles Curtis, of Chicago, is president.

TEXAS

BURLESON COUNTY

Texas Fullers' Earth Company—This company, which owns a deposit of fullers' earth, near Somerville, is now making preparations for marketing the product, and expects its plant to be in full operation by April 1. It is constructing a plant on the main line of the Gulf, Colorado & Santa Fé Railway, about 75 miles north of Houston, at a cost of $35,000. All machinery has been ordered. Officers of the company are: George W. Norrell, president; W. M. Rice, vice-president and assistant general manager; N. W. Dunham, secretary and general manager; J. S. Rice, treasurer; P. S. Tilson, chemist. N. W. Dunham is in charge of operations at Somerville.

WASHINGTON

FERRY COUNTY

Colville Mining and Smelting Company—This company has been formed with a capitalization of $2,000,000, divided into 2,000,000 shares. Republic, Wash., is the principal place of business. A branch office has been established at 42 Broadway, New York. The trustees for the first year are: G. Weaver Loper (president and general manager) and J. Q. Thompson, of New York City; Charles N. Jacobs and R. H. Galbraith, of Cincinnati, O.; M. R. Staight, secretary; G. V. Alexander and J. C. Caie, of Republic, Wash. The principal object of this company is to develop the Mountain Boy, Silver King, Little Girl, Copper King, and Mountain Boy Fraction claims, at Park City camp, on the south half of the Colville reservation, about 25 miles southeast of Republic.

The Mountain Boy claim has yielded some very rich ore, and always paid a profit when worked to advantage.

Bortle Copper-Gold Company—The shaft is down 60 ft. to the foot wall of the vein, and a winze has followed the footwall down about 20 ft., and averages 15x7 ft. in the clear. A drift has been driven from the head of the winze 20 ft. southwest along the footwall. From 5 ft. below the collar of the shaft those openings are all in solid iron sulphide ore, with no sign of a hanging wall in sight. Considering the depth the showing is by far the best looking on Belcher mountain. Upward of 500 tons of ore have been extracted and placed on the dump, which the superintendent estimates will average 2 per cent. copper, in addition to other contents, and net $10 per ton at the smelter, after paying mining, transportation and treatment. The company is now employing on exploration and development 20 men on 2 shifts.

Copper Key—A connection has been made between the upper adit, 250 ft. from the portal, and the bottom of the winze, in the old workings, and the mine is again in good condition to ship ore, of which a large tonnage is in sight. The connection was made by raising 40 ft. above the adit level.

Winnipeg—The main shaft is down 200 ft., and some drifting and crosscutting has been done on two levels to demonstrate the width and value of the vein. An adit has been driven 785 ft., to tap the vein about 300 ft. deep. Lately some rich, but small stringers of ore were cut which show well in chalcopyrite and are similar to streaks found in the upper workings. A survey has been made for a raise from the tunnel to connect with the upper workings.

Oversight—A number of new pits have been sunk along the trend of different veins on the group during the winter, some of them with encouraging results. The principal work has been done, however, on the Pin Money shaft, which is now down about 60 ft. Fifty sacks of ore are on the dump awaiting shipment. An average sampling of the vein gave the following analysis: Cobalt, 2.45 per cent.; copper, 2 per cent.; arsenic, 44 per cent.; iron, 25 per cent.; sulphur, 20 per cent.; silica, 3.40 per cent. Accommodations have been provided in the way of ore bins at the most eligible points on the group and at the railway sidings, and new wagon roads have been built recently.

WISCONSIN

ZINC DISTRICT

Several prominent engineers have been going over this district systematically and they report a promising future.

With the present facilities of transportation from mine to railroad, production will be retarded, but the producers are quite confident that the new electric road will run so as to be of great assistance to them.

Benton Camp is fast approaching second place as a producer and shipper. As soon as the new strike at the Aetna is developed and separating plants are put in operation it will be pushing Platteville for first place. The Dall will be shipping again soon; the roaster that was destroyed by fire has been replaced by a steel structure, with all the latest improvements.

Foreign Mining News

BRITISH COLUMBIA—SLOCAN

Byron White Company—This company has closed down its Slocan Star mine and concentrating mill near Sandon in the Slocan district. They will probably remain idle until a decision is reached in the pending litigation with the Star Mining Company over extra-lateral rights.

NEW BRUNSWICK

New Brunswick Petroleum Company—Arrangements are being made to turn this company's property over to a London company, which will provide working capital for further exploration.

Wentworth Copper Company, Ltd.—This company has been organized under a special charter, to take over the copper property at Wentworth, which was formerly owned by the Cumberland Copper Company, and was sold out under foreclosure. The new company has made provision for the old stock and other claims, and proposes to work the property.

ONTARIO—COBALT DISTRICT

Jacobs—A sample of rich ore from this mine, Cobalt, has been received at the Provincial Bureau of Mines. It is of dyscrasite, a combination of silver and antimony, and weighs about 10 lb., showing high values.

McKinley-Darragh—The plant at Cobalt is being replaced by larger and better machinery which is now on the ground, comprising two 80-h.p. boilers, 12-drill compressors and a large hoist. The old plant will be installed at the Savage mine, which is owned by the same company. The cofferdam inclosing four acres of the end of Cobalt lake, embraced in their property, is nearly completed.

O'Brien—From this mine Cobalt, four cars of high-grade ore have been shipped to the smelter at Copper Cliff near Sudbury, Ont. It is claimed that assays show a record value per ton. A government official accompanied the shipment and will stay at the smelter until the value is definitely determined, as under the recent arrangement the Province is entitled to a royalty of 25 per cent. Two cars of low-grade ore are being treated at an American smelter.

Timiskaming—In this mine, Cobalt, a rich strike has been made at the 70-ft.

level, where the vein is 8 in. wide. A nugget weighing several hundred pounds, which was extracted, is now on exhibition in Toronto.

Nipissing—It was announced on Feb. 4 that four directors, known as the International Nickel party, had resigned from the board of the Nipissing Mines Company. The retiring directors are: Capt. J. R. De Lamar, Ambrose Monell, E. C. Converse and Robert M. Thompson. Their places are to be taken by W. B. Thompson, Eugene Meyer, Jr., Frank Schirmer, and J. G. Hopkins.

Ore Shipments—Shipments of Cobalt ore over the Timiskaming & Northern Ontario Railway for the week ending Jan. 26 were officially reported as follows: Silver Queen, 125,683 lb.; Nipissing, 124,177; University, 61,385; O'Brien, 60,570; Coniagas, 56,720; Cobalt Townsite, 47,160; Buffalo, 40,000; Total, 515,695 pounds.

New Companies—One week's incorporations are 14 mining companies—including two American companies licensed to operate in Ontario—with a total capitalization of $13,585,000. The largest is the Larder Lake Proprietary Gold Fields, with $3,000,000. The Ontario Boston-Cobalt, chartered in Maine, has $2,000,000 capital.

ONTARIO—HASTINGS COUNTY

E. B. Davis, an experienced miner, has made a discovery of gold about nine miles north of Madoc village. A sample weighing 10 lb. has been brought to Belleville. It consists of milky quartz, dolomite and black country rock, and has free gold. The find has caused great excitement in the locality.

Central Ontario Granite and Marble Company—The first piece of marble was lifted at the quarry near Bancroft last week, a big Chandler machine having been installed.

Henderson Talc Mine—Shipments of talc from this mine, near Madoc, during 1906 amounted to 1102 gross tons, which were sent to New York, Cincinnati, Newark, N. J., and Maryland. This season's output is expected to be considerably larger.

Ontario Pyrite Company—This company, the headquarters of which are in New York, is developing the Oliver property in the twelfth concession of Hungerford township. It is putting in a complete mining outfit and has a shaft 45 ft. down.

MEXICO

CHIHUAHUA

Rio Plata Mining Company—A report from D. W. Shanks, general manager, notes the completion at the mine of a number of necessary buildings; also of the telephone and electric light plants. A new trail to the mine 100 km. long, has been opened. A masonry retaining wall and dam have been built. An important work is the water-power plant, which is to operate the mill and other machinery The flume grade starting at the river with a tunnel 6½ ft. high, 5 ft. wide and 151 ft. long and an open cut 40 ft. long, has been cut into the mountain side for 5099 ft. to a point above the stamp-mill where the flume will deliver the water to the pressure pipe. One cut, 600 ft. long is 20 ft. high and others vary from 5 ft. to 30 ft. In addition to the intake tunnel there are four others, 40 ft., 55 ft., 55 ft. and 94 ft. in length respectively, and an open cut 84 ft. long. There are two bridges, one 62 ft. and the other 40 ft. Most of the grade has been cut in the solid rock, 162,000 cu.ft. of material having been moved. The flume is 3 ft. 4 in. wide by 1 ft. 6 in. high, inside measurement. There are 4x6-in. sills every 4 ft., into which are mortised uprights which in turn carry cross-pieces making solid mortised frames at intervals of 4 ft. for the entire length. The pressure pipe is 402 ft. long and weighs 16,000 lbs. It is being carried in on mules in 4-ft. lengths all punched ready for riveting. In making the excavation for the plant 125,000 ft. of material, principally rock, was moved and 8028 cu.ft. of masonry retaining walls built. For the battery pit an excavation in rock 48 ft. long, 6 ft. wide and 8 ft. deep was made. In all 200,000 lb. of machinery and supplies have been delivered at the mine, necessitating the constant employment of 200 mules on the trail. This machinery has been despatched promptly from the warehouse at Aguatos, though much trouble has been experienced in the failure of manufacturers to make deliveries according to agreement, which has made it impossible to complete the plant in the time first estimated. All of the delayed machinery will have been delivered at Aguatos by February. Fortunately the stamp-mill was delivered on time. From 150 to 175 Mexican laborers are constantly employed, together with a large force of American and Mexican machinists and carpenters. The mine is 99 miles from the railroad and when the plant is completed it will have made a record in mountain transportation and quick construction

GUANAJUATO

Mexican Mining Company—At the annual meeting of this company, held Jan. 18 in Pittsburg, the officers reported an excellent condition of the mines and the following vote of thanks was offered: "Resolved, that a vote of thanks be tendered C. C. Auld, the officers and board of directors for what has been accomplished to date and for the great encouragement offered." The favorable report from the officers, the present outlook at the mines and the announcement that the officers were negotiating for the erection of the mill were well received. The directors and officers elected were as follows: C. C. Auld, president; A. Vignos, first vice-president; T. W. D. Heber, second vice-president; Jas. L. Morrow, secretary; M. S. Riggs, treasurer; W. J. Aber, assistant secretary and treasurer; Thomas Maxwell, W. M. Holmes, Fred Volquarts.

The Guanajuato district, in which the company is operating, is now fast coming to the front in the way of developing new mines, unwatering old propositions that were worked by hand process, and supplying them with machinery and up-to-date methods.

AFRICA

RHODESIA

Gold production in December was 48,329 oz. bullion. For the full year the total was 409,836 oz. bullion in 1905, and 551,895 oz. in 1906; an increase of 142,059 oz. The bullion reported in 1906 was equal to 491,187 oz. fine gold, or $10,152,835. Other production reported in Rhodesia for the year includes 120,574 oz. silver, an increase of 31,296 oz.; 652 tons lead, an increase of 82 tons; 44 tons of copper; 15 tons wolframite; 2339 tons chrome ore; 5512 tons zinc ore. The output of coal from the Wankie mines was 103,803 tons, an increase of 6612 tons.

WEST AFRICA

Gold output reported in December was 22,276 oz. For the full year it was 167,537 oz. in 1905, and 221,591 oz. in 1906; an increase of 54,054 oz. last year.

EUROPE

GERMANY

A cable from Saarbrücken, Rhenish Prussia, Jan. 28, says: A fire-damp explosion occurred today in the Bildstock shaft of the Reden mine at Saint Johann-on-Saar, opposite this town. Up to this afternoon the bodies of 164 miners had been recovered; 17 men dangerously injured had been rescued. An outbreak of fire has driven out the rescuers. It is considered probable that 30 to 40 men are still in the pit. The number of dead is now estimated at 200. About 600 men were working in the shaft when the explosion occurred, but more than half of them were not in the wrecked galleries. Rescuers worked desperately in efforts to reach the entombed men.

NEW ZEALAND

Dr. James Macintosh Bell, of Canada, was appointed director of the New Zealand survey, in February, 1905, and since that has reorganized it. The staff now includes, in addition to the director, the following officers: Alex. McKay, geologist and paleontologist; P. G. Morgan, general geologist; Colin Fraser, mining geologist; Ernest John Webb, assistant geologist; Edwin Clark, assistant geologist; R. P. Geville, topographer; R. J. Crawford, draftsman; John Thompson, secretary.

SOUTH AMERICA

PERU

A new double-drum electrically driven hoisting engine built by the Lidgerwood Manufacturing Company for the Inca Mining Company was shipped recently. The Santo Domingo mines, for which the hoist is destined, lie in Peru and behind the Lake Titicaca region. The mines were discovered about twelve years ago by a couple of Peruvians. A year later the property was acquired by a party of Bradford, Penn., men and the Inca Mining Company formed. Work on the mines was begun about eleven years ago, and more than $2,500,000 in gold has been taken out up to this time. The company has about 30 miles of tunnels, shafts and drifts opened up. The hoist is to be placed in a tunnel which has been run 1700 ft. into the mountain, cutting the vein 1500 ft. below the outcrop at the top of the hill. A 500-ft. shaft has been sunk from the tunnel, and the new hoist is to bring the ore from the lower workings to the tunnel level. Accompanying the hoist are two 200-kw. General Electric generators. These will furnish current generated from a water-power which will operate the hoist, mill and other machinery. The mill contains 10 stamps, a concentrating and a cyaniding plant. The hoist will go by steamer to the port of Mollendo; from there by railroad to Tirapata; thence for 100 miles over a wagon road, which reaches the summit of the Andes at Lake Arracoma, 16,000 ft. above sea-level. The next 50 miles is only a mule road. To make it possible to transport the big hoist over this part of the route it was built in sections, with no one piece weighing more than 300 lb. The total weight of the hoist is 13,800 lb. The drums are each 48 in. diameter with 40-in. faces.

Coal Trade Review

NEW YORK, Feb. 13

The coal trade in the West has been rather irregular, the main cause having been stormy weather and heavy snows, which have still further complicated the railroad situation. The shortage of cars has increased and the delay in transporting coal has been serious. Not only the smaller towns, but some of the large consuming centers are bare of reserve stocks and must depend on the daily receipts. There is much discussion over remedies for this state of affairs, but no practicable plan has been brought forward.

In the East, cold weather has started up the domestic trade. Steam coal remains in steady demand, and is in rather short supply. Transportation has been delayed by snow and bad weather, and the trade is directly affected thereby.

COAL-TRAFFIC NOTES

Shipments of coal and coke originating on the Pennsylvania Railroad Company's lines east of Pittsburg for the year to Feb. 2 were as follows, in short tons:

	1906.	1907.	Changes.
Anthracite	498,961	488,935	D. 10,026
Bituminous	3,422,533	3,502,681	I. 80,148
Coke	1,196,469	1,229,734	I. 33,265
Total	5,117,963	5,221,350	I. 103,387

There was an increase of 2 per cent. in the total this year.

Anthracite coal shipments in January are reported as follows, in long tons:

	1906. Tons.	Per Ct.	1907. Tons.	Per Ct.
Reading	1,098,385	20.1	1,070,898	20.4
Lehigh Valley	958,548	17.6	883,360	16.8
N. J. Central	714,250	13.1	633,351	12.1
Lackawanna	829,352	15.2	862,500	16.4
Del. & Hudson	552,061	10.1	526,026	10.0
Pennsylvania	492,145	9.0	507,607	9.6
Erie	567,467	10.4	532,500	10.2
N. Y., Ont. & W.	245,876	4.5	233,704	4.5
Total	5,458,084	100.0	5,249,946	100.0

The total decrease this year was 208,138 tons, or 3.8 per cent. Only two companies—the Delaware, Lackawanna & Western and the Pennsylvania—showed gains. The tonnage of the Delaware, Susquehanna & Schuylkill, or Coxe Bros. & Co., is now included in that of the Lehigh Valley road.

The coal and coke tonnage of the Chesapeake & Ohio Railway for the six months of its fiscal year, from July 1 to Dec. 31, was as follows, in short tons:

	Coal.	Coke.	Total.
New River	2,671,696	97,546	2,769,242
Kanawha	1,777,386	42,873	1,820,259
Kentucky	83,509	.....	83,509
Connecting lines	233,733	55,887	289,620
Total	4,766,324	196,306	4,962,630
Total, 1905	4,197,567	229,196	4,426,763

The total increase for the half-year was 12.1 per cent. Deliveries of material originating on the line in 1906 were: Points west of mines, 2,211,531 tons coal and 105,905 tons coke; points east, 852,761 tons coal and 34,514 tons coke; tidewater, 1,468,299 tons coal.

Coal and coke tonnage of the Baltimore & Ohio Railroad for the 11 months ending Nov. 30, was as follows, in short tons:

	1905.	1906.	Changes.
Anthracite	960,932	864,759	D. 96,173
Bituminous	20,346,995	23,031,330	I. 2,684,335
Coke	4,417,105	5,387,624	I. 970,519
Total	25,725,032	29,283,713	I. 3,558,681

The total gain in 1906 was 13.8 per cent., notwithstanding the decrease in anthracite.

Coal receipts at Boston for the full year were as follows, in long tons:

	1905.	1906.	Changes.
Anthracite	1,977,398	1,659,679	D. 317,719
Bituminous	2,798,290	3,548,385	I. 750,095
Total domestic	4,775,688	5,208,064	I. 432,376
Foreign coal	608,471	658,072	I. 49,601
Total	5,384,159	5,866,136	I. 481,977

Some of the foreign coal came from Great Britain, but the larger part was from Nova Scotia. The total increase was 9 per cent.

Coal receipts at St. Louis for the 11 months ending Nov. 30 were 5,449,791 tons in 1905, and 6,840,760 tons in 1906; an increase of 1,390,969 tons, or 25.5 per cent., last year.

Receipts and shipments of coal at all lake ports for the 11 months ending Nov. 30 were, in short tons:

	1905.	1906.	Changes.
Receipts	12,034,735	14,547,528	I. 2,512,793
Shipments	13,879,279	16,712,761	I. 2,833,482

The difference between shipments and receipts—1,844,544 tons in 1905, and 2,165,233 tons in 1906—is accounted for by coal furnished to vessels and by shipments to Canadian ports.

Coastwise shipments of coal from the chief Atlantic ports for the 11 months ending Nov. 30, were as follows:

	Anthracite.	Bituminous.	Total.
New York	12,739,518	9,527,131	22,266,649
Philadelphia	1,613,736	3,586,473	5,200,209
Baltimore	211,309	2,925,478	3,136,787
Newport News	.....	2,624,208	2,624,208
Norfolk	.....	1,979,906	1,979,906
Total	14,564,563	20,643,196	35,207,759
Total, 1905	15,640,402	19,274,301	34,914,703

The total increase was 293,056 tons, or 0.8 per cent. New York includes all the New York harbor shipping points.

New York Feb. 11

ANTHRACITE

The anthracite market is slowly recovering from the effects of the recent storm, which seriously menaced the movement of coal during the past week. However, the roads are still suffering from considerable congestion due mainly to the difficulty of handling cars at switching and terminal stations, rather than to difficulties along the line. Another factor which has played an important part in delaying shipments and causing car shortage is the fact that many locomotive engineers have been sick and no class of men on a railroad can be spared less easily than the engineer.

The demand for hard coal has been good and the supplies, in spite of the above conditions, have been very fair. The scarcity of coal exists principally among the small steam sizes, producers reporting that it is practically impossible to supply any of these sizes, except those already contracted for. Prices remain unchanged at $4.75 for broken, $5 for egg, stove and chestnut. Small steam sizes are quoted nominally at $3 for pea, $2.25@2.50 for buckwheat, $1.50 for rice, $1.40 for barley; all f.o.b. New York harbor shipping points.

BITUMINOUS

The Atlantic Seaboard soft-coal trade has been affected materially by weather conditions; coal in the cars is badly frozen, and the loading of vessels is accordingly delayed. This prevents free deliveries, and a continuation of this state of affairs would produce a shortage of stocks among consumers. Outside of this, trade is generally a little quiet. Inquiries on contracts for next season's business still continue, but the railroads have not yet named their through rates, which prevents contract prices being made. It is understood that a few speculators have been offering coal, taking their chances on favorable rates. It seems to be the general idea that an advance of 10c. per ton

will be made on all soft coals, beginning April 1. The car-supply question has again become an active issue; the West Virginia fields have been feeling this particularly this month.

Trade in the far East does not seem to be active. The better transportation conditions during January permitted good stocks of coal to be accumulated, hence the needs of this district are not so urgent. Trade along the Sound is absorbing quite a little coal.

New York harbor trade is quiet. Fair grades of steam coal can be bought for from $2.65@2.75 f.o.b. New York harbor shipping ports. All-rail trade has been taking its regular quota of coal. Car supply is poor and the West Virginia mines, outside of a few favored ones, receive from 10 to 20 per cent. of their requirements. Transportation from mines to tide is slow and irregular, due solely to weather conditions. In the coastwise trade vessels are very much congested, owing to an ice blockade in the Chesapeake and the Delaware. We quote freight rates from Philadelphia to Boston, Salem and Portland at $1@1.10 and discharge, loading and discharging clause included.

Birmingham Feb. 11

The coal output is somewhat better than it has been, as the railroads begin to furnish better service. However, there is need for more cars in this district and more locomotive power. The mine operators state that the demand for coal was never more satisfactory than at present. The development in the coal fields of Alabama is being pushed. In Jefferson and Walker counties the development is on a large scale. Some work is being done now in Tuskaloosa county. Coal lands in the lower part of Jefferson and in Tuskaloosa county are being bought up right along.

The legislature has under consideration now laws covering the mining operations in Alabama, the mine employees being interested in amendments looking to a better protection of life.

Chicago Feb. 11

Both bituminous and anthracite sales continue brisk under the demand created by cold weather. Illinois and Indiana coals are fairly well regulated as to supply and demand, the amount of demurrage coal on track being small. Eastern coals are generally firm and in fairly good demand.

Prepared sizes from Illinois and Indiana bring $2.25@3.50; run-of-mine, $1.75@2.25, and screenings $1.25@1.60.

Eastern coals are firm, owing to transportation difficulties and increased demand, due to cold weather. Hocking sells for $3.40@3.65, with new business chiefly at the higher figure. Smokeless is strong as to run-of-mine, which holds up firmly to $3.40; lump and egg smokeless are firmer but not strong yet. Youghiogheny is bringing $3.15@3.25.

Anthracite is steadily increasing in demand and everything indicates a strong market until April. Chestnut size is scarce.

Cleveland Feb. 12

The heavy consumption of coal, due to the continued cold weather, has given additional strength to the market. The stocks on hand have been used up almost altogether and the market is depending upon shipments direct from the mines. Slack is almost off the market, due to heavy previous buying and the lessened production. There is not much promise of relief until three-quarter coal starts to move toward the lake. Ohio mine-run is sold on the basis of $1.20@1.25 at mines. Slack is selling at about the same figure. Pennsylvania mine-run is worth $1.10@1.15 at the mine and Pennsylvania slack will bring $1@1.05 easily at mines.

This week there has been started a movement to consolidate the mines in No. 8 district. The promoter is Thomas W. Latham, supported by Lawrence Barnum & Co., of New York. For the present the report looks a good deal like a feeler. There are no possibilities of immediate developments, although they may come later. The plan is to merge 100 mines, with a capitalization, to the new company, of $20,000,000. The lake trade would be most influenced, since the announced intention is to engage principally in that end of the busness. Nothing has been done yet looking to the making of rates for the coming season of navigation, and prices have not yet been agreed upon or suggested. It seems possible, however, the up-lake prices will be about the same as last year.

The coke market is just a little easier. Last-half delivery of 72-hour foundry coke is selling at $4, which is also the spot price. Furnace coke is selling at $3.50@3.75 at oven.

Pittsburg Feb. 12

Coal—The coal market is a trifle weaker, and mines are running almost to capacity, there being an adequate supply of railroad cars. Prices have sagged a little and some contracts are being made as low as $1.05 a ton for mine-run coal. The severe weather this week has strengthened prices for prompt shipment, and sales have been made on a basis of $1.15 for mine-run coal at mine. All the river mines are running in full, and there are enough empty coal boats and barges in the pools and harbor to keep them going for several months.

Connellsville Coke—Prices have declined and spot furnace coke is quoted at $3.50@3.60, but for contracts running through the year the price seems to be firm at $3.15@3.25. This is due to the heavy purchases made by the H. C. Frick Coke Company late last year, when the bulk of the available output of a large number of independent concerns was contracted for. Foundry coke is weaker, as demand has fallen off, and for spot shipment $3.90@4.10 is quoted, and for contracts running through the year $3.75 can easily be done. The *Courier*, in its summary, gives the production of the Connellsville region for the week at 284,720 tons, and for the Lower Connellsville region 125,986 tons, the total production for both regions being 410,706 tons. Shipments for the week aggregated 14,195 cars, distributed as follows: To Pittsburg, 4689 cars; to points west of Connellsville, 8007 cars; to points east of Connellsville, 1499 cars.

Pittsburg Coal Company—The annual meeting of the stockholders was held at Jersey City, N. J., Feb. 11. William Flinn, of Pittsburg, was elected a member of the board of directors, in place of Francis L. Robbins, resigned, and J. C. Dysert was chosen to fill the vacancy on the board caused by the death of Charles Donnelly. The directors now are: Grant B. Schley, M. H. Taylor, George T. Oliver, John A. Bell, D. L. Gillespie, A. W. Mellon, W. R. Woodford, John I. Bishop, C. E. Wales, Alexander Dempster, Henry R. Rea, Calvary Morris, J. Denniston Lyon, William Flinn and J. C. Dysert. The board will meet in a few days and elect officers. Francis L. Robbins will retire as chairman and President M. H. Taylor will assume the duties or the office will be abolished. Mr. Robbins has been elected president of the Monongahela River Consolidated Coal and Coke Company, which is controlled by the Pittsburg Coal Company, and has transferred his interests to that company.

Foreign Coal Trade

Feb. 13

Imports of fuel into Belgium for the full year were as follows, in metric tons:

	1905.	1906.	Changes.
Coal	4,230,313	5,350,584	I. 1,120,271
Coke	359,404	350,381	D. 9,023
Total	4,589,717	5,700,965	I. 1,111,248

The larger imports were from Germany and Great Britain. Exports for the year were as follows:

	1905.	1906.	Changes.
Coal	4,681,489	4,974,416	I. 292,927
Coke	977,086	856,580	D. 120,506
Briquets	483,138	459,663	D. 23,475
Total	6,141,713	6,290,659	I. 148,946

The more important shipments were to France and Holland.

Iron Trade Review

New York, Feb. 13

The iron and steel markets are somewhat quieter than they have been. Pig iron, especially, is easier, the pressing demand having slackened off, so that prices have not been quite so strong.

In finished material demand is easier in some lines, but there is a strong call still for plates and bars, while new plans calling for structural material continue to come forward.

There has been some commotion in the British iron market, pig-iron warrants having fallen sharply. This is the result, in fact, of the easier market here, the warrant prices having been forced up to a high level in anticipation of continued heavy exports to this country.

Baltimore Feb. 12

Imports of spiegeleisen for the week were 157 tons; of ferro-manganese, 587 tons. Receipts of iron ore were two cargoes, 11,000 tons, from Cuba. One cargo, 2910 tons iron pyrites, was received from Huelva, Spain.

Birmingham Feb. 11

Southern pig-iron manufacturers are beginning to announce that they have sold up well on the probable make for the third quarter in this year already. The inquiry is still strong for iron to be delivered during the last quarter of the year, and some sales are being made. The iron masters in this section are in a strong position, having sold their probable make for several months ahead at good prices. No. 2 foundry, delivery at any time after the second quarter of the year, has not been selling for some days under $19 per ton. Even at that price it is hard to find iron for delivery during the third quarter.

The iron make in this section of the country is about holding its own. One of the Sloss-Sheffield furnaces at North Birmingham has been blown out for repairs. The Shelby Iron Company is manufacturing charcoal iron at Shelby and the second furnace there is in shape for operation, on coke or charcoal, whenever desired.

Several bills have been prepared and will get before the legislature which will affect mining and manufacturing. The alleged pollution of streams of water by coal refuse from coal washers, the prohibition of operation of freight trains in Alabama on Sundays, taxes on corporations, are bills that give some concern Representatives have been sent to the capital city off and on in the interest of bills pending which are looked upon as likely to affect the interests mentioned.

The Red Ore Iron Company has been incorporated in this district by W. M. Byrd, Henry Hiden and Y. A. Dyer, the first named being president and the last, secretary. The capitalization of the company is placed at $60,000 and ore mining will be its business. This is one of a number of mining companies being organized to supply furnace companies with extra ore as the iron production is increased.

The Alabama Consolidated Coal and Iron Company has had some changes in officials. Guy Johnson, vice-president and general manager, is now in charge. M. W. Bush is assistant to the president. H. Hammond has resigned as assistant to the president and general sales agent, and with William M. Byrd, has formed a iron brokerage firm. J. Banks Hudson has been appointed superintendent of the Ironaton furnaces, in place of J. G. Thompson, who has gone to the Woodstock Iron Company.

The Birmingham Car and Manufacturing Company, recently organized in this district by C. Ellis Foust and associates, to manufacture small cars and car wheels, will erect a plant at North Birmingham.

Chicago Feb. 11

Both sales and inquiries on Northern and Southern iron have been strong in the last week, giving indication of a good market, for both present and future supplies. There is evident desire of melters to cover their requirements for the last half of the year; many of them have succeeded in making contracts for their probable needs, but the feeling of the trade is that much iron must be sold on quick-delivery contracts to supply the extra demands that will be sure to arise. The postponement for a month of the 25c. advance on iron to the Chicago district from Southern furnaces has equalized somewhat the demand for spot iron, but the chief interest of the trade centers in contracts for third and fourth quarters.

Northern No. 2 iron sells for $24.50@25; Southern No. 2 for $23.10@23.60 and Lake Superior charcoal for $25.50@26.50, on general orders. Southern furnaces, according to reports, are likely to advance prices, but it is difficult to see how they can do this in the face of strong competition from such Northern furnaces as are not sold up.

Coke is active, with the best Connellsville bringing $6.65 Chicago, or $4 at ovens. The supply of coke is good, there being little demurrage material on tracks.

Cleveland Feb. 12

Iron Ore—The market for iron ore is quiet. The consumption of the stocks on hand is more rapid than was believed likely at the close of navigation. The sales off the docks are fairly heavy at 1907 prices.

Pig Iron—There has come a decided lull in the pig-iron trade. This is natural, since it follows one of the biggest months in the history of the trade. January was unusually brisk. February so far has been dull. The prices have even eased a little. Spot shipment Northern No. 2 is now selling at $25, the same price being paid for delivery through the first half. This compares with $25.50@26, charged recently. For the time second-half No. 2 is selling at $22 in the Valleys, although it is possible to shade that price. Southern No. 2 for second-half delivery is being sold on the basis of $18.50@19 Birmingham. First-half delivery is almost out of the question. In this territory specifications against contracts are heavy, in some cases the consumers anticipating contract requirements. The market has let up a good deal nevertheless.

Finished Material—Just now the employees of the American Shipbuilding Company are threatening to strike for a nine-hour day and 10 hours' pay, the piece-workers wanting a corresponding increase. This would tie up about all the construction and repair yards and limit the demand for finished plates and shapes. Otherwise the market is healthy and active. There is a good demand for billets at old prices. Bar iron is strong, on account of scrap prices. Bar steel is being substituted for bar iron, and is in demand. Sheets are active at the old prices, and the customary increase in the business, with the promise of spring, is in evidence. There is not much buying, of rails, usually, in this territory, but some big traction enterprises are under consideration and the prospects are the demand will be heavier than it has been for several years.

Pittsburg Feb. 12

The week has been a quiet one in the iron and steel markets, but there has been no decline in strength, except possibly in bessemer pig iron, and this was expected. There is considerable talk, emanating from New York principally, regarding probable cancelations of orders by railroads, due to inability to finance contemplated undertakings. While it seems true that some roads will be unable to obtain necessary funds to carry out proposed plans, particularly in regard to bridge work, the material ordered that may not be taken will not seriously affect the situation. Even if large tonnages of railroad business are canceled, the steel mills have orders on their books against which specifications have been made that will keep them going steadily until November at least, and there is enough actual business in sight to keep them busy until the middle of 1908. The Carnegie Steel Company alone has absolute specifications for over 1,000,000 tons of finished steel products, and is sold up in some lines until the third quarter. In wire, sheets and tin-plate the markets are decidedly strong. There has been a lull in new business in structural material, but this is probably due to the fact that mills cannot guarantee deliveries, and some large enterprises figured on for the coming summer may be deferred. Specifications for plates from lake shipyards and from other sources are unusually large, but contrary to expectations there has been a less demand from steel-car interests. The car-making concerns are filled with orders and have enough business booked to keep them running all year. So bright has been the outlook that the Standard Steel Car Company began the erection of an additional plant, which is located in Indiana.

The tin-plate mills are practically sold up for the first half and the independents continue to book large orders for delivery in the third quarter at 10c. a box above the established price of $3.90 a box. So far the American Sheet and Tin Plate Company has done nothing beyond July 1, and an official order for an advance is expected at any time, when it is likely books will be opened for last-half business. The proposed advance, it is believed, will be greater than 10c. a box. The Carnegie Steel Company is still booking steel-rail orders, although the tonnages are not large. During the week orders for standard steel rails were received amounting to 6500 tons and orders for light rails totaled about 1500 tons. The company is sold up on light rails until July 1.

Pig Iron—The market is dull this week and active buying of bessemer for second half is still being delayed, as consumers evidently believe the price will be lower later on. This was indicated when a sale was made last week of 2000 tons for third-quarter delivery at $21.35, Valley furnaces, which is 15c. a ton below the minimum price established by the furnaces for last-half delivery. The representative of a large furnace interest, when asked today if the rate of $21.50 would be maintained for second half, replied: "If we can get it. We may get more or may take less." This is taken as an indication that the producers are not altogether certain that they will be able to maintain a high price for bessemer iron. There is no doubt as to foundry-iron prices, and sales are being made for delivery at $21.50@22, Valley, and for prompt shipment furnaces have no difficulty in getting $25@25.50. A sale of 1500 tons of basic iron for delivery in the second quarter was made yesterday at $22, Valley furnaces. About 5000 tons of bessemer iron for delivery before July 1 were made last week at $22, Valley. Three of the five blast furnaces in the Eliza group of the Jones & Laughlin Steel Company are still idle, although two are expected to be blown in this week. Nos. 2 and 3 are out on account of accidents and No. 5 was blown out to avoid an accident. The repairs have been made as rapidly as possible, as by the idleness the company loses over 1500 tons of bessemer pig iron daily. If it has bought iron to make up this loss, the transactions have been kept quiet, as there is no record of sales having been made. Demand for gray forge is light and for prompt delivery is quoted at $22.85, Pittsburg.

Steel—The market for billets is easier and mills are catching up on deliveries. Some of the small mills are offering billets, but prices have not declined, bessemer billets being firm at $29.50 and open-hearth at $32. Plates remain at 1.70c. and merchant-steel bars at 1.60c.

Sheets—Since the advance in prices of galvanized sheets three weeks ago, specifications on old contracts have been very heavy. The mills are filled for several months ahead. Black sheets are decidedly strong and for prompt shipments premiums are paid. Quotations remain unchanged, with black sheets at 2.60c and galvanized at 3.75c. for No. 28 gage.

Ferro-Manganese—The market is lower for future delivery, $69 being quoted for shipment after July 1 and $70 for delivery in the second quarter. For prompt delivery prices remain about the same, ranging from $73 to $74 a ton.

Dusseldorf, Germany Feb. 6

The German Iron and Steel Union reports the output of the blast furnaces in December at 1,069,638 tons of pig iron; an increase of 8066 tons over November. For the full year the production was as follows, in metric tons:

	1905. Tons.	Per Ct.	1906. Tons.	Per Ct.
Foundry iron	1,905,668	17.3	2,108,684	16.8
Forge iron	827,498	7.5	854,536	6.9
Steel pig	714,335	6.7	943,573	7.6
Bessemer pig	425,237	3.9	482,740	3.9
Thomas pig	7,114,885	64.7	8,088,534	64.8
Total	10,987,623	100.0	12,478,067	100.0

The increase last year in foundry iron was 203,016 tons; forge iron, 27,038; steel pig—which includes spiegeleisen, ferromanganese, ferrosilicon and similar alloys—229,238; bessemer pig, 57,503; Thomas, or basic pig, 973,649; the total gain being 1,490,444 tons, or 13.6 per cent.

Metal Market

NEW YORK, Feb. 13

Gold and Silver Exports and Imports.

At all United States Ports in December and year.

Metal.	Exports.	Imports.	Excess.
Gold:			
Dec. 1906	$1,729,194	$ 7,588,623	Imp. $5,859.429
" 1905	2,668.532	4,028,881	" 1,360,349
Year 1906	46,560,397	155,550 766	" 108,990,369
" 1905	46,794,467	50,293,405	" 3.498 938
Silver:			
Dec. 1906	5,486.094	4.122,324	Exp. 1,363,770
" 1905	8,196,149	4,692.746	" 3,503,403
" 1906	59,036,340	44,350.896	" 14,685 444
1905	57 518,102	35,939,135	" 21,573.967

These statements cover the total movement of gold and silver to and from the United States. These figures are furnished by the Bureau of Statistics of the Department of Commerce and Labor.

Gold and Silver Movement, New York.

For week ending Feb. 9 and years from Jan. 1.

Period.	Gold. Exports.	Gold. Imports.	Silver. Exports.	Silver. Imports.
Week	$ 43,500	$ 79,838	$533,877	$ 19,770
1907	1,389,085	498,277	2,548,540	331,304
1906	1,053,875	238,678	10,931,748	286,199
1906	27,546,865	413,297	4,105,083	119,798

Exports of gold for the week were to Haiti; of silver to London. Imports for the week, both gold and silver, were from the West Indies and South America.

The joint statement of all the banks in the New York Clearing House for the week ending Feb. 9 shows loans, $1,099,356,400, an increase of $1,518,900; deposits, $1,065,562,500, a decrease of $11,157,500, as compared with the preceding week. Reserve accounts show:

	1906.	1907.
Specie	$190,894,500	$190,382,100
Legal tenders	80,286,800	79,354,400
Total	$271.181,300	$269,736,500
Surplus	$5,943,575	$3,345,875

The surplus over legal requirements shows a decrease of $2,928,700, as compared with the previous week.

Specie holdings of the leading banks of the world on Feb. 9 are reported as below, in dollars:

	Gold.	Silver.	Total.
Ass'd New York	.....	.....	$190,382,100
England	$177,370,705	.....	177,370,705
France	529,328,105	$197,169,490	726,497,595
Germany	158,118,750	52,706,250	210,825.000
Spain	77,075,000	122,360,000	199,435,000
Netherlands	27,755,500	28,800,500	56,856,000
Belgium	16,426,665	8,213,335	24,640,000
Italy	161,210,000	23,686,500	184,896,500
Russia	590.255,000	23,675,000	613,930,000
Aust.-Hungary	231,975,000	60,240,000	292.215,000
Sweden	20,275,000	.....	20.275,000

The banks of England and Sweden report gold only. The New York banks do not separate gold and silver in their reports.

Shipments of silver from London to the East are reported by Pixley & Abell as follows, for the year to Jan. 31:

	1905.	1906.	Changes.
India	£ 2,087 300	£ 496 510	D. £ 1,590,790
China	.....	.....	.....
Straits	.....	76,300	I. 76,300
Total	£ 2,087,300	£ 572,810	D. £ 1,514 490

Receipts for the week were £12,000 from the West Indies, £295,000 in bars and £30,000 in Mexican dollars from New York; a total of £337,000. Exports were £76,300 coin to the Straits, £50,000 Mexican dollars and £50,000 bars to India; £176,300 in all.

Notwithstanding the purchases of gold in Australia, Indian exchange has continued strong, and the Council bills offered in London were taken at an average of 16.09d. per rupee.

The Treasury Department's estimate of the amount and kinds of money in the United States on Feb. 1 is a follows:

	In Treasury.	In Circul'n.
Gold coin (inc. bullion in Treasury)	$ 250,005,397	$ 695,539,841
Gold certificates	35,006.180	617,564,689
Silver dollars	2 948,490	83,173,040
Silver certificates	12 705,811	462,936,189
Subsidiary silver	7,066,315	120,408,160
Treasury notes of 1890	14,460	6,473,543
U. S. notes	8,121,292	338,559,724
Nat. Bank notes	17,950,662	578,246,907
Total	$333,818,607	$2,902,902,093

Population of the United States on Feb. 1 estimated at 85,484,000; circulation per capita, $33.96. For redemption of outstanding certificates an exact equivalent in amount of the appropriate kinds of money is held in the treasury and is not included in the account of money held as assets of the Government. The statement of money held in the treasury as assets of the Government does not include deposits of public money in national-bank depositaries to the credit of the Treasurer of

the United States, amounting to $149,327,789. The amount in circulation Feb. 1 shows an increase of $19,001,765 over Jan. 1; and an increase of $222,272,161 over Feb. 1 of last year.

The total value of gold received at the United States assay office at Seattle, Washington, in 1906, was $23,346,938, as compared with $18,873,850, in 1905. The year just closed was a record one, the highest total of any previous year having been $22,038,796, in 1900. Of the gold received last year $5,670,086 was from the Canadian Yukon, $1,396,314 from British Columbia, and $16,141,492 from Alaska. The grand total of gold received at this office since its establishment is $139,353,686, of which Alaska contributed $47,060,099, the Canadian Yukon $82,365,352, and British Columbia $8,113,863. The remainder came from Oregon, Washington, Idaho and Montana, with a small amount from miscellaneous sources.

Prices of Foreign Coins

	Bid.	Asked.
Mexican dollars	$0.531	$0.55
Peruvian soles and Chilean	0.484	0.49
Victoria sovereigns	4.854	4.87
Twenty francs	3.86	3.89
Spanish 25 pesetas	4.78	4.80

SILVER AND STERLING EXCHANGE.

February.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.	February.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.
7	4.84¾	68⅛	31 9/16	11	4.84½	68⅜	31¾
8	4 84¾	68⅛	31 11/16	12	.....	....	31 11/16
9	4.84½	68¾	31 11/16	13	4.84½	68¾	31 11/16

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Other Metals

Daily Prices of Metals in New York.

February.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. Cts. per lb.	Spelter. New York, Cts. per lb.	Spelter. St. Louis, Cts. per lb.
7	25 @25⅛	24¾ @25	106¾	42⅜	6.00	6.75 @6.80	6 60 @6.65
8	25 @25½	24¾ @25	106¾	42¼	6.00	6.75 @6.80	6.60 @6.65
9	25 @25⅛	24¾ @25	.....	42¼	6.00	6.75 @6.80	6.60 @6.65
11	25 @25½	24¾ @25	106⅞	42½	6.00	6.75 @6.80	6.60 @6.65
12	.....	.....	107	....	....	.....	.....
13	25 @25⅛	24¾ @25	108	42¼	6.00	6.75 @6 80	6.60 @6.65

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electrolytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions as made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The lead prices are those quoted by the American Smelting and Refining Company for near-by shipments of desilverized lead in 50-ton lots, or larger. The quotation on spelter are for ordinary western brands; special brands command a premium.

Copper—There have been some large sales for domestic consumption, extending as far ahead as June delivery, at unchanged prices, but the foreign demand has been inconspicuous. There are reports from the West that production in the different mining centers has been and is still materially curtailed, owing to a scarcity of fuel and for various other reasons. On this account it is feared that there is no relief in sight from the shortage of supplies, from which the market has been suffering for some time past. Quotations at the close are 25@25½ for lake; 24¾@25 for electrolytic in ingots, cakes or wirebars, and 24¼@24½ for casting copper.

The London market fluctuated rather erratically, quotations at one time showing a severe decline from the close of last week, but a sudden reaction set in, which placed spot at the close at £108 and three months at £109.

Refined and manufactured sorts we quote: English tough, £110@111; best selected, £114 10s.@115 10s.; strong sheets, £124@125.

Copper Sheets—The base price of copper sheets is 32c. per pound, an increase of 2c. over last week.

Copper Wire—The base price of copper wire, No. 0000 to No. 8, is 27¼@27½c. per pound.

Tin—The market has fluctuated within narrow limits and in London maintained the characteristics noted during the past few weeks. In that market the close is easy at £191 15s. for spot and £191 for three months.

In this market there is still a scarcity of near-by deliveries, which are being quoted at 42¼, while shipment tin is dealt in at 42c.

Lead—The quotation remains unchanged at 6c. New York.

The London market has eased off slightly, and at the close quotations are cabled at £19 10s. for Spanish lead and £19 12s. 6d. for English.

Spelter—The market is very firm and a good business is reported from day to day. The close is quoted at 6.75@6.80 New York, and 6.60@6.65 St. Louis. Spot deliveries still command a premium.

The foreign market has recovered somewhat from the recent decline and quotations at the close are given as £26 2s. 6d. for good ordinaries, and £26 7s. 6d. for specials.

Zinc Sheets—The base price is $8.40 per 100 lb. (less discount of 8 per cent.) f.o.b. cars at Lasalle and Peru, in 600-lb. case for gages No. 9 to 22, both inclusive; widths from 32 to 60 in., both inclusive; the lengths from 84 to 96 in., both inclusive. The freight rate to New York is 27.5c. per 100 pounds.

Antimony—There are indications of a better tendency. Quotations remain unchanged at 23¼@24c. for ordinary brands; 24@24¾c. for Hallett's, and 25@25¾c. for Cookson's.

Nickel—For large lots, New York or other parallel delivery, the chief producer quotes 45@50c. per lb., according to size and terms of order. For small quantities prices are 50@65c., same delivery.

Platinum—Demand continues strong and prices high. Unmanufactured platinum is quoted at $38 per oz. For good scrap $31.50@32 is paid.

Quicksilver—There is no change. New York prices are $40.50@42 per flask of 75 lb., according to size and conditions of order. San Francisco prices are $39@40 per flask for domestic orders, and $37@38 for export trade. The London quotation is £7 per flask, with £6 16s. 3d. asked by jobbers.

Aluminum—Prices are steady and demand good. Prices for ton lots, or over, are: No. 1, over 99 per cent. pure metal, 36c. per lb.; No. 2, over 90 per cent., 34c. Small lots are 1 to 3c. higher, according to size. Rods, according to size, are 1c. per lb. up, over the price of ingots. Granulated metal is 2c. per lb. over ingots.

Missouri Ore Market

JOPLIN, Feb. 9

The highest price reported paid for zinc was $52 per ton, on an assay basis quoted by purchasing agents at $47@49.50 per ton of 60 per cent. zinc. As high as a basis of $50 per ton is reported by one seller. The average price, all grades, for the week is $47.14.

The highest price reported paid for lead was $88.50 per ton, and the week closed active between the St. Louis Smelting and Refining Company and the Granby Mining and Smelting Company, with the Picher Lead Company nominally out of the market, as the latter company dropped offerings to $81 per ton of 80 per cent. lead. The average price of the week, all grades, was $84.66.

The Hammer Paint Company is reputed to have purchased the lead smelter at Galena, Kansas. Preparations are making for firing it and buyers are in the field taking small quantities. About five carloads have been purchased the past two weeks.

Predictions are made that with the advent of three new buyers for the Mineral Point Zinc Company in the field soon, that prices of zinc concentrate may be several dollars higher in March. That company has secured three good men to take charge of the purchasing in this district, and large and commodious quarters are being installed in an uptown location. Purchases have been made heretofore, but it was done through the agent of the Prime Western Spelter Company.

Following are the shipments of zinc and lead from the various camps for the week ending today:

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	4,481,010	601,450	$133,105
Joplin	2,08 ,7[illegible]0	282,770	63,167
Galena-Empire	978,500	136,030	29,265
Alba-Neck City	1,141,470	2,[illegible]10	28,682
Prosperity	310,970	240,710	17,693
Duenweg	633,340	48,220	17,249
Aurora	62?,130	15,870	12,490
Badger	405,780	.....	10,144
Oronogo	329,920	23,510	9,016
Spurgeon	288,190	62,240	8,080
Granby	306,000	36,000	5,373
Carthage	173.580	.....	4,339
Carl Junction	117,250	3,670	2,966
Baxter Springs	.....	69,100	2,882
Zincite	82,940	.....	1,990
Sherwood	44,680	10,810	1,52[illegible]
Totals	12,00[illegible],510	1,532.740	$347,917
Six weeks	68,292,?80	9,2[illegible]3,060	$1,962,235

Zinc value, the week, $282,934; six weeks, 1,572,795
Lead value, the week, 64,983; six weeks, 389,440

The following table shows the average monthly prices of zinc and lead ores in Joplin, by months; the average for zinc being based on the prices of assay basis ores carrying 60 per cent. zinc:

ZINC ORE AT JOPLIN.			LEAD ORE AT JOPLIN.		
Month.	1906.	1907.	Month.	1906.	1907.
January	47.38	45.84	January	75.20	83.58
February	47.37	.....	February	72.83	.....
March	42.68	.....	March	73.73	.....
April	44.63	.....	April	75.13	.....
May	40.51	.....	May	78.40	.....
June	43.83	.....	June	80.96	.....
July	43.25	.....	July	74.31	.....
August	43.56	.....	August	75.36	.....
September	42.58	.....	September	79.64	.....
October	41.55	.....	October	79.84	.....
November	44.13	.....	November	81.98	.....
December	43.68	.....	December	81.89	.....
Year	43.24	.....	Year	77.40	.....

Wisconsin Ore Market

PLATTEVILLE, Feb. 9

Local buyers bought all the ore produced. The demand was strong, and buying began early in the week, last week's price of $48 per ton prevailing. Several choice lots were reported sold at prices ranging above $50. There was, as usual, a brisk demand for the unroasted ore.

Whether the continued activity and demand for zinc ore is due to pressing requirements at the smelters or simply a desire to load up for future stock, is hard to ascertain, but the latter is probably the reason. Preparation is being made on every hand to take care of increased production. The railroads are doing all within their power to get coal in and ore out, but the general scarcity of cars continues.

The camps of the district loaded ore for the week ending Feb. 9 as follows:

Camps.	Zinc, Lb.	Lead, Lb.	Sulphur, Lb.
Platteville	204.720	.....	...
Buncombe-Hazel Green	184,900	.....	.....
Linden	195.140	.....	.....
Benton	156 100	.....	.....
Highland	132,000	.....	.....
Rewey	104.500	.....	.....
Galena	82,000	.....	.....
Livingston	56 000	.....	.....
Mineral Point	27,450	55,000	.....
Total for week	1.142.870	55,000	.....
Year to Feb. 9	8,874,035	412,890	95,480

The Platte mine, one of the large producers of the Platteville camp, shut down during the week, and it is reported that the present management will probably not resume operations, for some time, at least.

Chemicals

NEW YORK, Feb. 13

Copper Sulphate—The market remains steady, and business is good. Prices are unchanged, at $7.25 per 100 lb. for carload lots or over, and $7.50 per 100 lb. for smaller parcels.

Nitrate of Soda—The official figures for the movement of nitrate for the year are reported as follows, in long tons:

Shipments:	1905.	1906.	Changes.
Europe	1,224.932	1,335,689	I. 110,757
United States	353,197	330,806	D. 22,391
Other countries	52 092	40,904	D. 11,188
Total shipments	1,630,221	1,707 399	I. 77,178
Deliveries:			
Europe	1,192.120	1,241,400	I. 49,280
United States	305,000	361.900	I. 56,900
Other countries	46,000	36,000	D. 10,000
Total deliveries	1,543,120	1,639,300	I. 96,180

Stocks on Jan. 1, 1907 were: Chile, 430,000 tons; Europe, 190,420; afloat, 546,020; total, 736,440 tons, showing an increase of 59,210 tons over those at the beginning of 1906. The production was 1,733,664 tons in 1905, and 1,800,819 tons in 1906; an increase of 67,155 tons.

Mining Stocks

NEW YORK, Feb. 13

Some recovery in the general stock markets can be noted this week. The situation is still rather uncertain, but liquidation is less in evidence, and it begins to look as if a sounder position might soon be reached. Mining stocks, as for some weeks past, have been the most active section of the market, both in New York and Boston, and dealings continue large.

Boston Feb. 12

The continued strength of Amalgamated has put a little more life into the mining-share list and certain specialties have advanced sharply the last week. As remarked last week, some of the banking institutions are better disposed toward this class of securities in the matter of accepting copper shares as collateral, which is bound to prove more and more beneficial. The talk that New York is to list some of Boston's copper shares and thereby deprive this center of its reputation as the market for these stocks should be taken with a grain of salt. Boston is the natural center and will undoubtedly continue to be. La Salle was taken from the curb Friday and put among the unlisted stocks on the exchange, with the result that it broke from an introductory price of $31 to $27. This is the course usually followed in such instances of late. Quincy went to $148, Wednesday, closing Monday at $142, the same as a week ago. According to a Quincy director $18 per share will be paid for the current calendar year.

Greene Consolidated recorded an advance from $31.37½ to $33.25. The rise Monday was sharp and was not accompained with any rumors. Calumet & Arizona made its best price Wednesday at $197.50, closing at $192.50 last night. The advance was caused by the fact that the quarterly dividend was increased $1 to $5. Butte Coalition became active and advanced $3.37½ to $38.87½. The next dividend is expected to be 50c. quarterly, against the present rate of 40c. Wolverine touched $200 per share and a further increase in the dividend from $18 per annum is now expected, possibly to $24. Old Dominion spurted $4.37½ to $58.37½ during the week and Utah Consolidated is up $1.25 to $73.75 on pronounced New York buying. Granby rose $17.50 to $150.50 and Amalgamated is up $2.87½ to $114.75 per share.

Corbin mining stock has been the curb feature, being an Amster creation. There are but 80,000 shares, par $5. Allotments were cut down to 15 and 20 per cent. It rose steadily to $9.37½. The curb is extending continually.

Colorado Springs Feb. 8

The market has been dull and featureless the entire week. Prices have held steady with no fluctuations. The only stock showing any activity worth mentioning is Isabella, which had sales of only 24,500 shares for the week. Portland still continues weak, owing to the threatened lawsuit against the directors by James F. Burns, the largest stockholder. There are reports of rich strikes on the Acacia and Doctor Jack Pot properties, but these reports cannot be confirmed today.

Salt Lake City Feb. 8

At the annual meeting of the stockholders of the Salt Lake Stock and Mining Exchange a governing board, consisting of H. W. Doscher, Clark L. Whitney, R. J. Evans, W. J. Browning, J. L. Hamilton, James A. Pollock, F. R. Davis, Geo. T. Badger and William H. Child, was elected. James A. Pollock was re-elected president.

San Francisco Feb. 7

The San Francisco Stock and Exchange Board has adopted a new plan of management, a governing committee of seven having been appointed, who will control all matters heretofore decided by a majority of the whole board. A general revision of the rules that govern the board is not unlikely to be proposed. There is an element in the stock board favoring the adoption of some rule applicable to listing stocks, by which working mines and prospects may be classified for the information of all concerned. Moreover, considerable attention will in the future be devoted to finding out something definite about the mining properties seeking to be listed; some investigation will be made as to the character of the properties and of the men promoting them. All this will be for the better protection of the stock-dealing public, and should result in keeping a lot of wild-cats off the market.

The board has also contracted for a new three-story building on Bush street, between Montgomery and Kearny. By this move it will secure permanent quarters that will be as large as those occupied in the old Stock Exchange building, on Pine street, or about twice the size of the room now used. Surrounding the enclosure where the sales are carried on, a raised floor, above the brokers, will be constructed so that what is said can be heard more easily. The building will be occupied entirely by the San Francisco Stock and Exchange Board, and the offices of brokers, so that the business will be centralized and convenience secured for all who have dealings in mining stocks.

STOCK QUOTATIONS

NEW YORK Feb. 11	
Name of Comp.	Clg.
Alaska Mine	1⅜
Am.Nev.M.&P.Co.	3¾
Amalgamated	114⅜
Anaconda	295
Balaklala	11
British Col. Cop.	10¼
Buffalo Cobalt	2¾
Butte & London	2⅛
Butte Coalition	38⅛
Butte Cop. & Zinc.	5⅜
Cobalt Contact	⅜
Colonial Silver	3⅝
Cum. Ely Mining.	11⅞
Davis Daily	18½
Dominion Cop.	6⅞
El Rayo	5¾
Foster Cobalt	2¼
Furnace Creek	2⅛
Giroux Mine	10⅛
Gold Hill	4⅞
Greene Gold	2
Greene G. & S	2
Greenw'r & D.Val	1⅝
Guanajuato	4½
Guggen. Exp	305
Hanapah	⅜
McKinley Dar.	2⅛
Micmac	6⅝
Mines Co. of Am.	2⅛
Mitchell Mining.	5¾
Mont Sho.C.(New)	12½
Nev. Utah M. & S.	4⅜
Newhouse M. & S.	19
Nipissing Mines	12½
Old Hundred	37⅛
Silver Queen	2½
Stewart	2⅜
Tennessee Copper	50½
Union Copper	¾
Utah Apex	8½
West Columbus	17½

N. Y. INDUSTRIAL	
Am. Agri. Chem.	
Am. Smelt. & Ref.	144¼
Am.Sm. & Ref., pf.	114½
Bethlehem Steel	18
Colo. Fuel & Iron.	49⅜
Federal M.& S.,pf.	92⅛
Inter. Salt	15⅜
National Lead	71½
National Lead, pf.	102
Pittsburg Coal	
Republic I. & S.	36
Republic I.& S.,pf	98¾
Sloss-Sheffield	70⅛
Standard Oil	540
Tenn. C. & I.	
U. S. Red. & Ref.	
U. S. Steel	45¾
U. S. Steel, pf.	105¼
Va. Car. Chem.	33¼
Va. I. Coal & Coke	89½

ST. LOUIS Feb. 9		
N. of Com.	High.	Low.
Adams	.40	.20
Am. Nettie	.08	.06
Center Cr'k	2.50	2.20
Cent. C. & C.	65.00	63.50
C.C. & C pd.	80.00	79.00
Cent. Oil	60.00	50.00
Columbia	5.00	4.00
Con. Coal	24.00	22.50
Doe Run	160.00	140.00
Gra. Bimet.	.33	.25
St. Joe	19.00	17.00

BOSTON Feb. 11	
Name of Comp.	Clg.
Adventure	5
Allouez	66½
Am. Zinc†	47
Arcadian	13
Atlantic	17
Bingham	31½
Boston Con.	30⅝
Calumet & Ariz	192½
Calumet & Hecla	960
Centennial	45⅞
Con. Mercur	.50
Copper Range	94½
Daly-West	
Franklin	28
Granby*, New	149½
Greene Con.	33½
Isle Royal	30½
Mass.	8⅛
Michigan	22
Mohawk*	93½
Mont. C. & C.(new)	2
Nevada	17½
North Butte	114⅛
Old Colony	1⅜
Old Dominion	57⅛
Osceola*	166
Parrot	34¾
Phoenix	2½
Quincy†	142
Rhode Island	10⅞
Santa Fe	5⅛
Shannon	22¾
Tamarack*	153
Tecumseh	
Trinity	36⅞
United Cop., com.	73⅛
U. S. Oil	12
U. S. Smg. & Ref.	63
U.S.Sm.& Re.,pd.*	46
Utah Copper*	73¾
Victoria	8
Washington	
Winona	13
Wolverine	198
Wyandotte	2¾

*Ex. Div. †Ex. Rights.

BOSTON CURB	
Ahmeek	110
Ariz. Com.	37
Black Mt.	8¾
Cananea Cent.	35
East Butte	15¾
Hancock Con.	15⅛
Keweenaw	12⅞
Majestic	3⅞
Raven	1⅜
Shawmut	1¾
Superior	
Superior & Pitts.	28
Troy Man.	3¼

LONDON Feb. 13			
Name of Com.	Clg.		
Dolores	£1	11s	3d
Stratton'sInd.	0	3	0
Camp Bird	1	7	9
Esperanza	2	14	4½
Tomboy	2	1	3
El Oro	1	9	0
Oroville	1	0	0
Somera	0	6	3
Utah Apex	1	13	1
Ariz.Cop.,pfd.	3	15	0
Ariz.Cop.,def.	3	12	6

Cabled through Hayden, Stone & Co., N. Y.

S. FRANCISCO Feb. 5	
Name of Comp.	Clg.
COMSTOCK STOCKS	
Belcher	.36
Best & Belcher	1.35
Caledonia	.54
Challar	.12
Con. Cal. & Va.	.90
Crown Point	.25
Exchequer	.50
Gould & Curry	.32
Hale & Norcross	.90
Mexican	.90
Ophir	2.30
Overman	.18
Potosi	.16
Savage	.90
Sierra Nevada	.53
Union	.40
Utah	.04
Yellow Jacket	.93
TONOPAH STOCKS	
Golden Anchor	.40
McNamara	.63
Montana-Pitts.ex.	.25
North Star	.39
Rescue	.19
GOLDFI'D STOCKS	
Black Ants	.13
Blue Bull	.50
Columbia Mt.	1.07
Comb. Frac.	5.87
Conqueror	.28
Daisy	2.80
Florence	3.00
Frances-Mohawk	.82
Goldfield Con.	8.87
Grandma	.31
Great Bend	1.10
Red Hills	.31
St. Ives	1.15
BULLFROG STOCKS	
Amethyst	.57
Bonnie Claire	.40
Mayflower Con.	.53
Montgomery Mt.	.40
Original	.24
MANHAT'N STOCKS	
Gold Wedge	.15
Manhattan Mg.	.16
Pine Nut	.24
Ruby Wonder	.34
Yellow Horse	.08

NEVADA Feb. 13 (Weir Bros. & Co., New York)	
TONOPAH STOCKS	Clg.
Tono'h Mine of N.	17.12½
Tonopah Exten.	4.87½
Montana Tonop'h	3.95
Belmont	5.62½
Tonopah Midway	2.05
West End Con.	1.55
Jim Butler	1.06
GOLDFI'D STOCKS	
Sandstorm	.73
Kendall	.53
Red Top	3.75
Jumbo	3.75
Goldfield Mining.	1.30
Dia'dfield B. B. C.	.52
Atlanta	.84
Mohawk	17.00
Silver Pick	1.44
Laguna	1.38
BULLFROG STOCKS	
Mont. Shoshone C.	12.75
Tramps Con.	1.54
Gold Bar	1.25
Bullfrog, Mining.	.37
Bullfrog Nat. B.	.52
Homestake Con.	1.35
MANHAT'N STOCKS	
Manhattan Con.	.90
Manhat'n Dexter.	.52
Jumping Jack	
Stray Dog	
Indian Camp	

COLO. SPRINGS Feb. 9	
Name of Comp.	Clg.
Acacia	12
Black Bell	4¼
C. C. Con.	6
Dante	
Doctor Jack Pot.	7½
Elkton	62
El Paso	54½
Findley	67
Gold Dollar	6¾
Gold Sovereign	6⅞
Isabella	22⅜
Index	6¾
Jennie Sample	
Jerry Johnson	
Mary McKinney	63
Pharmacist	6⅝
Portland	1.16
Un. Gold Mines	
Vindicator	95
Work	14

New Dividends

Company.	Payable.	Rate.	Amt.
Alaska Mexican	Jan. 28	$1.00	$200,000
Alaska Treadwell	Jan. 28	0.50	90,000
Alaska United	Jan. 28	0.30	90,000
Amalgamated Copper	Feb. 25	2.00	3,100,000
Bunker Hill & Sullivan	Feb. 4	0.60	180,000
Calumet & Arizona		5.00	1,000,000
Cambria Steel	Feb. 15	0.62½	562,500
Dolores	Feb. 25	0.15	49,500
General Chemical	Mar. 4	2.00	148,206
Jamison, Cal.	Jan. 18	0.03	11,700
McKinley-Darragh, Ont.	Mar. 1	0.02	40,000
Mexican Co. M. & S.	Feb. 25	0.50	120,000
Philadelphia Co., pfd.	Mar. 1	1.25	143,620
Pocahontas Collieries, pfd.	Feb. 1	1.50	22,500
Quincy Copper	Mar. 11	4.50	486,446
Republic Iron & Steel, pfd.	Apr. 1	3.75	765,634
Snowstorm, Idaho	Feb. 1	0.03	45,000
Union Copper, Land & Ny.	Jan. 31	2.00	
U. S. Steel Corporation.	Mar. 30	0.50	2,541,513
U. S. Steel Corp., pfd.	Feb. 28	1.75	6,304,919
U. S. Cast Iron Pipe	Mar. 1	1.00	150,000
U. S. Cast Iron Pipe, pfd.	Mar. 1	1.75	262,500
U. S. Smelt., Ref. & Mg.	Apr. 1	0.87½	1,312,500

Assessments

Company.	Delinq.	Sale.	Amt.
Be mont, Idaho	Feb. 7	Mar. 7	$0.002
Black Diamond, U.	Feb. 13	Mar. 6	0.01
Bullion, Nev.	Feb. 11	Mar. 8	0.05
Crown Point, Nev.	Feb. 5	Feb. 26	0.10
Deer Lodge, Utah	Feb. 18	Mar. 11	0.00½
Forty-nine Placer, U.	Feb. 8	Feb. 27	0.01
Johnnie, Utah	Feb. 23	Mar. 12	0.02
Nevada Superior	Jan. 21	Feb. 9	0.10
New Stockton, Utah.	Feb. 18	Mar. 11	0.02½
N.Y.-GrassValle,Cal.	Jan. 30	Feb. 25	0.01
Oro Blanco, Cal.	Feb. 25	Apr. 22	0.03
Sierra Nevada	Feb. 25	Mar. 18	0.10
Scottish Chief	Feb. 6	Feb. 25	0.02
Tetro, Utah	Feb. 6	Mar. 11	0.03
Union Con., Nev.	Feb. 11	Mar. 4	0.10

Monthly Average Prices of Metals

AVERAGE PRICE OF SILVER

Month.	New York.		London.	
	1906.	1907.	1906.	1907.
January	65.288	68.673	30.113	31.769
February	66.108		30.464	
March	64.597		29.854	
April	64.765		29.984	
May	66.976		30.968	
June	65.394		30.185	
July	65.105		30.113	
August	65.949		30.529	
September	67.927		31.483	
October	69.523		32.148	
November	70.813		32.671	
December	69.050		32.003	
Year	66.791		30.868	

New York, cents per fine ounce; London, pence per standard ounce.

AVERAGE PRICES OF COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.			
	1906.	1907.	1906.	1907.	1906.	1907.
January	18.310	24.404	18.419	24.825	78.869	106.739
February	17.869		18.116		78.147	
March	18.361		18.641		81.111	
April	18.375		18.688		84.793	
May	18.475		18.724		84.867	
June	18.442		18.719		83.994	
July	18.190		18.585		81.167	
August	18.380		18.706		83.864	
Septemb'r.	19.033		19.328		87.831	
October	21.203		21.722		97.269	
November.	21.833		22.398		100.270	
December.	22.885		23.350		105.226	
Year	19.278		19.616		87.282	

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

AVERAGE PRICE OF TIN AT NEW YORK

Month.	1906.	1907.	Month.	1906.	1907.
January	36.390	41.548	July	37.275	
February	36.403		August	40.606	
March	36.662		September	40.516	
April	38.900		October	42.852	
May	43.313		November	42.906	
June	39.260		December	42.750	
			Av. year	39.819	

Prices are in cents per pound.

AVERAGE PRICE OF LEAD

Month.	New York.		London.	
	1906.	1907.	1906.	1907.
January	5.600	6.000	16.850	19.828
February	5.464		16.031	
March	5.350		15.922	
April	5.404		15.959	
May	5.685		16.725	
June	5.750		16.813	
July	5.750		16.525	
August	5.750		17.109	
September	5.750		18.266	
October	5.750		19.350	
November	5.750		19.281	
December	5.900		19.609	
Year	5.657		17.370	

New York, cents per pound. London, pounds sterling per long ton.

AVERAGE PRICE OF SPELTER

Month.	New York.		St. Louis.		London.	
	1906.	1907.	1906.	1907.	1906.	1907.
January	6.487	6.732	6.337	6.582	28.225	27.125
February	6.075		5.924		25.844	
March	6.209		6.056		24.563	
April	6.078		5.931		25.781	
May	5.997		5.846		27.000	
June	6.096		5.948		27.728	
July	6.006		5.856		26.800	
August	6.027		5.878		26.938	
September	6.216		6.056		27.563	
October	6.222		6.070		28.075	
November	6.375		6.225		27.781	
December	6.593		6.443		27.938	
Year	6.198		6.048		27.020	

New York and St. Louis, cents per pound. London in pounds sterling per long ton.